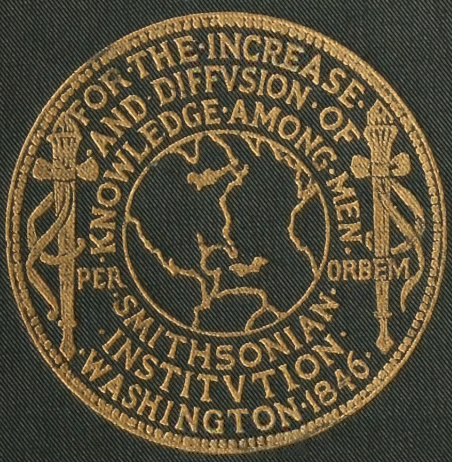
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PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

VOLUME 78

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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

VOLUME 78

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The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

The *Proceedings*, begun in 1878, is intended primarily as a medium for the publication of original papers, based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects.

The dates at which these separate papers are published are recorded in the table of contents of each of the volumes.

The present volume is the seventy-eighth of this series.

The *Bulletin*, the first of which was issued in 1875, consists of a series of separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogues of type specimens, special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution.

WASHINGTON, D. C., *August 15, 1931.*

CONTENTS

Article

ALDRICH, J. M. New two-winged flies of the family Calliphoridae from China. No. 2844, pp. 1–5. September 25, 1930 [1] 1

New genera: *Lispoparea, Xanthotryxus.*

New species: *Calliphora grahami, Lispoparea flava, Xanthotryxus draco, X. mongol.*

————. American two-winged flies of the genus Stylogaster Macquart. No. 2852, pp. 1–27. October 15, 1930 [1] .. 9

New species: *Stylogaster apicalis, S. banksi, S. breviventris, S. currani, S. decorata, S. fasciata, S. indistincta, S. panamensis, S. pectinata, S. peruviana, S. rectinervis, S. speciosa.*

————. Notes on the types of American two-winged flies of the genus Sarcophaga and a few related forms, described by the early authors. No. 2855, pp. 1–39. November 5, 1930 [1] 12

New species: *Notochaeta hinei, Sarcophaga morionella.*

BARTSCH, PAUL. New and old land shells from the island of Luzon, Philippines. No. 2848, pp. 1–20. November 25, 1930 [1] 5

New species: *Leptopoma mcgregori.*

New subspecies: *Cochlostyla dubiosa capulensis, C. persimilis acrybia, C. p. callimorpha, C. p. callipepla, C. p. pharcida, C. p. podagra, C. submirabilis antimonana, C. s. banosana, C. s. daragana, C. s. lucbana, C. s. majayjayana, C. s. tayabasana, Obba gallinula majayjayana, Sulfurina citrinella banahaoana.*

New name: *Cochlostyla persimilis boacana.*

BASSLER, R. S. (see ULRICH, E. O.) 4

BURT, CHARLES E., and BURT, MAY DANHEIM. The South American lizards in the collection of the United States National Museum. No. 2849, pp. 1–52. November 25, 1930 [1] .. 6

New species: *Plica stejnegeri.*

BURT, MAY DANHEIM (see BURT, CHARLES E.) 6

[1] Date of publication.

Article

CHANDLER, ASA C. New genera and species of nematode worms. No. 2866, pp. 1–11. March 11, 1931 [1]---------- 23

New family: Filariopsidae.
New genera: *Bourgelatioides, Litomosoides.*
New species: *Bourgelatioides traguli, Cystidicola harwoodi, Filariopsis arator, Litomosoides sigmodontis.*

COMPERE, HAROLD. A revision of the species of Coccophagus, a genus of hymenopterous, coccid-inhabiting parasites. No. 2850, pp. 1–132. March 12, 1931 [1]---------- 7

New species: *Coccophagus bivittatus, C. clavellatus, C. subaensis, C. flaviceps, C. gregarius, C. ishiii, C. isipingoensis, C. lepidus, C. lutescens, C. margaritatus, C. mariformis, C. nigritus, C. pulvinariae, C. robustus, C. silvestrii, C. specialis, C. speciosus, C. spectabilis, C. tarongaensis, C. tibialis, C. timberlakei.*
New variety: *Coccophagus modestus* Silvestri var. *capensis.*

CUSHMAN, R. A. Notes on ichneumon-flies of the genus Polycyrtus with descriptions of new species. No. 2857, pp. 1–62. March 31, 1931 [1]---------- 14

New species: *Polycyrtus (Cryptanuridimorpha) albiniclavus, P. (C.) buscki, P. (C.) inca, P. (Polycyrtus) areolaris, P. (P.) aerolatus, P. (P.) atrinasutus, P. (P.) bicarinatus, P. (P.) boliviensis, P. (P.) brevigenalis, P. (P.) bulbosus, P. (P.) carinispinis, P. (P.) circumfluens, P. (P.) colliculatus, P. (P.) confusus, P. (P.) constricticlavus, P. (P.) convergens, P. (P.) duplicatus, P. (P.) humerosus, P. (P.) impressus, P. (P.) infractus, P. (P.) inornatus, P (P.) inquinatus, P. (P.) isthmus, P. (P.) manni, P. (P.) medialbus, P. (P.) mediotinctus, P. (P.) minutus, P. (P.) nigriclypeatus, P. (P.) ornatifrons, P. (P.) paranensis, P. (P.) parviclavus, P. (P.) prominens, P. (P.) proximannulatus, P. (P.) saladonis, P. (P.) sulcatilobus, P. (P.) triangularis.*
New combinations: *Polycyrtus (Cryptanuridimorpha) capitator* (Fabricius) Brullé, *P. (C.) elegans* (Viereck), *P. (C.) tubulifera* (Viereck), *P. (Polycyrtus) semialbus* (Cresson).

FISHER, W. K. Report on the South American sea stars collected by Waldo L. Schmitt. No. 2859, pp. 1–10. April 7, 1931 [1]---------- 16

HOUGH, WALTER. Exploration of ruins in the White Mountain Apache Indian Reservation, Arizona. No. 2856, pp. 1–21. October 25, 1930 [1]---------- 13

HRDLIČKA, ALEŠ. Catalogue of human crania in the United States National Museum collections: Pueblos, southern Utah basket-makers, Navaho. No. 2845, pp. 1–95. April 9, 1931 [1]---------- 2

HUTCHINSON, GEORGE EVELYN. Restudy of some Burgess Shale fossils. No. 2854, pp. 1–24. November 4, 1930 [1]--- 11

New suborders: Euanostraca, Palaeanostraca.

[1] Date of publication.

Article

MALLOCH, JOHN R. Notes on some acalyptrate flies in the United States National Museum. No. 2858, pp. 1–32. January 10, 1931 [1] 15

New genera: *Marbenia, Mindanaia.*

New subgenera: *Plagiostenopterina (Bakeromyia), P. (Carolimyia), P. (Stenopterella).*

New species: *Diastata (Spilochroa) albibasis, D. (S.) peruviana, D. (S.) polita, Elassogaster hyalipennis, Euprosopia grahami, E. metallica, E. omei, E. semiarmata, Lamprogaster fulvescens, Marbenia peculiaris, Mindanaia latifasciata, Plagiostenopterina (Bakeromyia) armata, P. (B.) discolor, P. (B.) inermis, P. (Carolimyia) diptera, P. (Plagiostenopterina) dubiosa, P. (P.) parva, P. (Stenopterella) trivittigera, Pseudepicausta attenuata, P. completa.*

PRICE, EMMETT W. Redescription of two species of trematode worms from the MacCallum collection, with a note on the family Pronocephalidae. No. 2865, pp. 1–10. March 11, 1931 [1] 22

New subfamilies: Charaxicephalinae, Opisthoporinae.

RATHBUN, MARY J. Fossil decapod crustaceans from Mexico. No. 2851, pp. 1–10. November 1, 1930 [1] 8

New genus: *Montezumella.*

New species: *Calappilia hondoensis, Callianassa tepetatensis, Lobonotus mexicanus, Raninoides mexicanus, Montezumella tubulata, Xanthosia americana.*

REESIDE, JOHN B., JR., and WEYMOUTH, A. ALLEN. Mollusks from the Aspen shale (Cretaceous) of southwestern Wyoming. No. 2860, pp. 1–24. February 26, 1931 [1] 17

New genus: *Kanabiceras.*

New species: *Acompsoceras americanum, Aphrodina? aspenana, Epengonoceras aspenanum, Kanabiceras wyomingense, Mactra? aspenana, Periplomya? aspenana, Tancredia? lincolniana, Thracia? wyomingensis.*

SHAMEL, H. HAROLD. Notes on the American bats of the genus Tadarida. No. 2862, pp. 1–27. May 6, 1931 [1] 19

New species: *Tadarida constanzae, T. intermedia.*

SHOEMAKER, CLARENCE R. A new species of amphipod crustacean (Acanthonotozomatidae) from California, and notes on Eurystheus tenuicornis. No. 2861, pp. 1–8. March 11, 1931 [1] 18

New species: *Panoploea rickettsi.*

[1] Date of publication.

Article

Ulrich, E. O., and Bassler, R. S. Cambrian bivalved Crustacea of the order Conchostraca. No. 2847, pp. 1–130. April 13, 1931 [1] 4

New families: Beyrichonidae, Indianidae.
New genera: *Dielymella, Mononotella, Walcottella.*
New species: *Aluta* (?) *rimulata, Bradoria curta, B. elongata, B. medialis, B. tontoensis, Dielymella appressa, D. brevis, D. dorsalis, D. nasuta, D. recticardinalis, Hipponicharion confluens, H. parvum, H. plicatum, Indiana curta, I. faba, I. impressa, I. labiosa, I. longula, I. matthewi, I. suberecta, Polyphyma marginata, Walcottella apicalis, W. breviuscula, W. concentrica, W. leperditoides, W. limatula, W. longula, W. nitida, W. oblonga, W. obsoleta, W. pulchella, W. scitula, W. subtruncata, W. ventrosa.*
New varieties: *Bradoria benepuncta spissa, B. robusta longula, B. vigilans concentrica, Dielymella recticardinalis angustata, Indiana faba intermedia.*
New name: *Bradoria subquadrata.*

Webber, R. T. A revision of the North American tachinid flies of the genus Achaetoneura. No. 2853, pp. 1–37. December 10, 1930 [1] 10

New species: *Achaetoneura anisotae, A. cuculliae, A. euchaetiae, A. dimmocki, A. laniiferae, A. pholi, A. samiae, A. testacea, A. texana, A. westonia.*

————. A new parasitic fly of the genus Chaetophlepsis. No. 2863, pp. 1–4. March 26, 1931 [1] 20

New species: *Chaetophlepsis orbitalis.*

Wetzel, Rudolf. A new species of trematode worm of the genus Ornithobilharzia from a Canadian goose. No. 2846, pp. 1–4. October 25, 1930 [1] 3

New species: *Ornithobilharzia pricei.*

————. Description of a new species of amidostomine worm of the genus Epomidiostomum from the gizzard of anserine birds. No. 2864, pp. 1–10. March 19, 1931 [1] 21

New species: *Epomidiostomum crami.*

Weymouth, A. Allen (see Reeside, John B., jr.) 17

[1] Date of publication.

ILLUSTRATIONS

PLATES

A New Species of Trematode Worm of the Genus Ornithobilharzia from a Canadian Goose

By Rudolf Wetzel

Facing page

1. *Ornithobilharzia pricei*, new species 4

Cambrian Bivalved Crustacea of the Order Conchostraca

By E. O. Ulrich and R. S. Bassler

1–10. Cambrian Conchostraca 108–124

New and Old Land Shells from the Island of Luzon, Philippines

By Paul Bartsch

1–9. Land shells from the island of Luzon 20

A Revision of the Species of Coccophagus, a Genus of Hymenopterous, Coccid-inhabiting Parasites

By Harold Compere

1–2. *Coccophagus malthusi* Girault; female with parts named 116–117
3–4. Species of *Coccophagus* 118–119
5–6. Details of the thorax and abdomen of species of *Coccophagus* 120–121
7–9. Antennae of *Coccophagus* 122–124
10. Wings of *Coccophagus* 125
11. Stigmal veins of *Coccophagus* 126
12–13. Anatomical details of *Coccophagus* 127–128
14. Mandibles of *Coccophagus* 129

Fossil Decapod Crustaceans from Mexico

By Mary J. Rathbun

1. *Lobonotus mexicanus* 10
2. *Montezumella tubulata* 10
3. *Scylla costata* 10
4. 1, *Raninoides mexicanus;* 2, *Podophthalmus* (?); 3, *Calappa zurcheri* 10
5. 1, 2, *Calappilia hondoensis;* 3, *Calappa zurcheri* 10
6. 1, *Xanthosia americana*, 2, *Ranina* (?); 3, 4, *Calianassa tepetatensis* 10

RESTUDY OF SOME BURGESS SHALE FOSSILS

By George Evelyn Hutchinson

Facing page

1. *Aysheaia pedunculata* and *Opabinia regalis* 24

NOTES ON THE TYPES OF AMERICAN TWO-WINGED FLIES OF THE GENUS SARCOPHAGA AND A FEW RELATED FORMS, DESCRIBED BY THE EARLY AUTHORS

By J. M. Aldrich

1–3. Genitalia of flies of the genus *Sarcophaga* 40

EXPLORATION OF RUINS IN THE WHITE MOUNTAIN APACHE INDIAN RESERVATION, ARIZONA

By Walter Hough

1–6. White Mountain Apache Indian Reservation 20
7. Hafted stone blade from the Cliff House, White Mountain Apache Indian Reservation 20
8. White Mountain Apache Indian Reservation 20
9. Soapstone pipe from White Mountain Apache Indian Reservation 20
10. White Mountain Apache Indian Reservation 20

REPORT ON THE SOUTH AMERICAN SEA STARS COLLECTED BY WALDO L. SCHMITT

By W. K. Fisher

1–2. *Ophidiaster agassizii* 10
3. *Patiria chilensis* 10
4. *Patiriella calcarata* 10
5. *Patiriella fimbriata* 10
6–7. *Anasterias minuta* 10
8. *Anasterias* 10

MOLLUSKS FROM THE ASPEN SHALE (CRETACEOUS) OF SOUTHWESTERN WYOMING

By John B. Reeside, jr., and A. Allen Weymouth

1–4. Mollusks from the Aspen shale 24

DESCRIPTION OF A NEW SPECIES OF AMIDOSTOMINE WORM OF THE GENUS EPOMIDIOSTOMUM FROM THE GIZZARD OF ANSERINE BIRDS

By Rudolf Wetzel

1–2. *Epomidiostomum crami* and *Epomidiostomum uncinatum* 10

TEXT FIGURES

New Two-winged Flies of the Family Calliphoridae from China

By J. M. Aldrich

Page

1. *Calliphora grahami*, new species 2
2. *Xanthotryxus mongol*, new species 4
3. *Lisoparea flava*, new species 5

A Revision of the North American Tachinid Flies of the Genus Achaetoneura

By R. T. Webber

1–2. *Achaetoneura frenchii* (Williston) 10
3–4. *Achaetoneura euchaetiae*, new species 12
5–6. *Achaetoneura anisotae*, new species 14
7–8. *Achaetoneura samiae*, new species 16
9. *Achaetoneura melalophae* Allen 18
10–11. *Achaetoneura archippivora* (Williston) 23
12. *Achaetoneura frenchii* (Williston) 31
13. *Achaetoneura euchaetiae*, new species 31
14. *Achaetoneura samiae*, new species 31

Restudy of Some Burgess Shale Fossils

By George Evelyn Hutchinson

1–2. *Opabinia regalis* Walcott 4, 6
3. *Palaeanostraca* 8
4–5. *Aysheaia pedunculata* Walcott 15, 16

Exploration of Ruins in the White Mountain Apache Indian Reservation, Arizona

By Walter Hough

1. General sketch of ruins in group 2
2–4. Sketch of individual ruin 3–4
5. Sketch of ruin outlines west of Great Pueblo 5
6. Ceremonial pit with juniper tree 6
7. Plan of cliff house, Oak Creek 7
8. Plan of hill top ruin 9
9. Section of plaza in great ruin 11

Notes on Some Acalyptrate Flies in the United States National Museum

By John R. Malloch

1. Wing of *Euprosopia semiarmata* 3
2. Head of *Euprosopia semiarmata* from in front 3
3. Wing of *Euprosopia omei* 4
4. Head of *Euprosopia omei* from in front 4

Page
5. *Euprosopia grahami* 5
6. Wings of *Plagiostenopterina diptera* 18
7. Wing of *Plagiostenopterina plagiata* 18
8. Wing of *Mindanaia latifasciata* 25
9. *Marbenia peculiaris*, head from the side 32
10. *Marbenia peculiaris*, wing 32

REPORT ON THE SOUTH AMERICAN SEA STARS COLLECTED BY WALDO L. SCHMITT

By W. K. Fisher

1. *Ophidiaster agassizii* 2
2. *Astrostole platei* 5

A NEW SPECIES OF AMPHIPOD CRUSTACEAN (ACANTHONOTOZOMATIDAE) FROM CALIFORNIA, AND NOTES ON EURYSTHEUS TENUICORNIS

By Clarence R. Shoemaker

1–2. *Panoploea rickettsi*, new species 3–4
3–4. *Eurystheus tenuicornis* (Holmes) 6–7

REDESCRIPTION OF TWO SPECIES OF TREMATODE WORMS FROM THE MACCALLUM COLLECTION, WITH A NOTE ON THE FAMILY PRONOCEPHALIDAE

By Emmett W. Price

1. *Pleurogonius pomacanthi* (MacCallum, 1916) 3
2. *Opisthoporus aspidonectes* (MacCallum, 1917) 4

NEW TWO-WINGED FLIES OF THE FAMILY CALLIPHORIDAE FROM CHINA

By J. M. Aldrich

Associate Curator, Division of Insects, United States National Museum

The present paper includes four new species and two new genera of muscoid flies from China; one of the species has recently been introduced into California.

Genus CALLIPHORA Robineau-Desvoidy

Calliphora Rorineau-Desvoidy, Myodaires, 1830, p. 433.—Van der Wulp, Biologia, Dipt., vol. 2, 1896, p. 294.—Hough, Ent. News, vol 10, 1899, p. 65; Zool. Bull., vol. 2, 1899, p. 285.—Shannon, Insecutor Ins. Menst., vol. 11, 1923, p. 107; Proc. Ent. Soc. Wash., vol. 28, 1926, p. 134.—Malloch, Trans. New Zealand Inst., vol. 55, 1924, p. 640; Proc. Linn. Soc. New South Wales, vol. 52, 1927, p. 303.—Bezzi, Bull. Ent. Research, vol. 17, 1927, p. 240.—Lundbeck, Dipt. Danica, vol. 7, 1927, p. 149.

CALLIPHORA GRAHAMI, new species

Of the size and appearance of *vomitoria* Linnaeus, but having in both sexes no inner presutural bristle (presutural intraalar of Hough, hindmost sublateral of Shannon), beard wholly black, gray pollen of thorax and abdomen considerably more dense; the male also differs in having the front about three times as wide (0.14 of head width below front ocellus), and the genitalia greatly enlarged and of quite unique form.

The abdomen of the male is short and broad and the shining black genital segments (fig. 1) are very large, the first vertical, the second extending forward more than halfway to the base of the abdomen; first visible sternite short, second longer than usual, third and fourth short, curving downward, the fourth with more dense pile than preceding. Fifth prominent at base and bearing a dense tuft of short spines each side of middle line, not much separated; lobes large and widely divergent, the large median concavity bearing two long parallel lobes of soft structure, their tips turned outward, which are sepa-

rated from the more chitinized main lobes by a deep groove. Outer forceps shining black, giving off a pair of blunt processes at base, which project backward, the remainder long, extending forward and curving downward, of uniform width to tip, which is rounded. Inner forceps rudimentary, narrow, less than half as long as the outer. In repose the closely approximated outer forceps evidently lie in the median groove between the two soft inner lobes of the fifth sternite.

Thoracic chaetotaxy: acrostichal 3, 3; dorsocentral 3, 3; humeral 4; posthumeral 3 (sublateral of Shannon 3); pre-sutural 1; notopleural 2; supraalar 3; intraalar 2 (none close behind suture); postalar 2; scutellum with four lateral (apical included), one discal; sternopleural 2, 1.

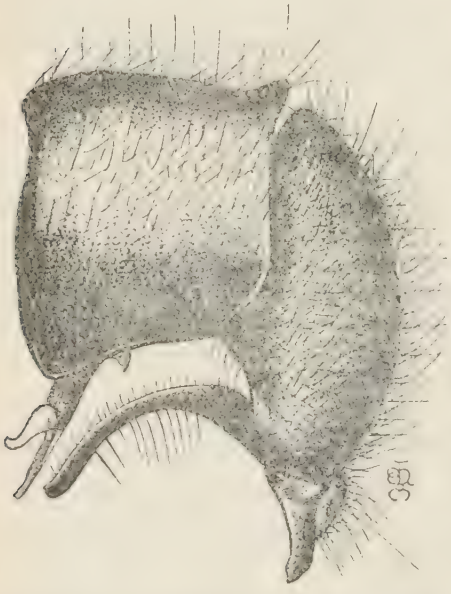

FIGURE 1.—CALLIPHORA GRAHAMI, NEW SPECIES. MALE, SIDE VIEW OF GENITAL SEGMENTS (DRAWN BY D. G. HALL)

Wing subhyaline, as in *vomitoria;* basicosta black, subcostal sclerite yellow, bare; third vein with three or four small hairs above and below. Hind calypter brown with white rim.

Length, 8–10 mm.

Described from 62 specimens of both sexes; 34, including type and allotype, were collected at Suifu, Szechuen Province, China, by Rev. D. C. Graham, after whom the species is named; one male from the same collector was collected at the summit of the range of mountains, Washan, same Province; and another male at Yellow Dragon Gorge near Songpan, in the same Province, was taken by the same collector at an altitude exceeding 12,000 feet. From E. Brunetti were received two males taken at Hang Kow, China, and two females from Hong Kong; while Prof. T. D. A. Cockerell sent a female which he took at Kongaus, Siberia, in August, 1923.

The remaining 29 specimens were received from H. H. Keifer, department of agriculture, California, who sent them in December, 1929, writing that he reared them all from a single batch of eggs that he found on meat at Sacramento, Calif. Thus it appears that the species has lately established itself in the United States. The California specimens are dated June 10, 1929. No other North American specimens are known.

Twenty of the Sacramento paratypes are returned to the California Department of Agriculture.

Type.—Male, Cat. No. 26865, U.S.N.M.

XANTHOTRYXUS, new genus

Near *Pollenia*, from which it differs especially in having the parafacials bare, and the face with a broad keel.

Hypopleural bristles present, postscutellum not developed; propleura and prosternum bare; eyes bare; vibrissae as high above oral margin as in *Pollenia rudis*, but farther apart; facial ridges with only a few setules above vibrissae; palpi normal, proboscis short, with ordinary labella; antennal axis and vibrissal axis about equal in length; frontal bristles reaching only to base of antennae; arista plumose. Thorax with dense deciduous curly pale hair; hind calypters bare, large. Abdomen robust, first sternite pilose, dense hair of dorsum becoming bristlelike apically. Wing with apical crossvein, the first posterior cell ending distinctly before apex; third vein with a few very delicate pale hairs above and below at base; subcostal sclerite with a tuft of yellow hairs; stemvein bare.

Genotype.—*Xanthotryxus mongol*, new species.

XANTHOTRYXUS MONGOL, new species

Black with dense appressed golden deciduous hair on thorax, the abdomen with dense golden pollen covering dorsum and becoming gray underneath.

Male.—Front narrow above, at narrowest hardly wider than distance across hind ocelli, thence rapidly widening and the face widening at same angle; parafrontals, parafacials, and upper part of face golden pollinose, lower face and cheek more gray; frontal stripe triangular, wide anteriorly, brown. Ocellars normal, proclinate, no large verticals nor reclinate frontals. The single row of convergent frontals begins some distance from the anterior ocellus and consists of about 15 bristles. Antennae black, third joint rather slender, twice the second; arista pale except at base, of moderate length, plumose almost to tip. Palpi black. Beard yellow, hairs of cheek black, cheek three-fourths of eye height.

Thoracic chaetotaxy: acrostichal 2, 3; dorsocentral 3, 4; humeral 3 or 4; posthumeral 1 (inner); presutural 1 (so far forward it might be called posthumeral); notopleural 2; supraalar 3; intraalar 2; postalar 2; sternopleural 1, 1; scutellum with 2 lateral, apical of same length. Postalar declivity with large tuft of yellow hairs; hind calypters brown, front ones yellow, the long pile at junction yellow.

Abdomen with suberect dense black hair, third segment with marginal row; fourth segment with irregular bristles and bristly hairs. Genital segments black, rather large, the first with spot of yellow pollen and numerous bristly hairs. Genitalia as figure (fig. 2), the inner forceps slender, as long as outer, united except at extreme tip. Legs black; claws and pulvilli elongated, the latter yellow; middle tibia with one small bristle on outer front side; base of hind coxæ bare behind. Wings brownish, especially along veins, yellowish near base; bend of fourth vein oblique, rounded, hence with slight concavity to costa.

Female.—Front at vertex 0.29 of head width; two verticals, one small reclinate frontal, two proclinate orbitals. Middle tibia with two bristles on outer front side. Claws and pulvilli small.

Length, 11–13 mm.

Described from seven males and five females, collected in Szechuen Province, China, by Rev. D. C. Graham; eight were taken at Chuan Chien and four on Mount Omei.

Type.—Male, Cat. No. 29163, U.S.N.M.

FIGURE 2.—XANTHOTRYXUS MONGOL, NEW SPECIES. MALE, SIDE VIEW OF GENITAL SEGMENTS (DRAWN BY D. G. HALL)

XANTHOTRYXUS DRACO, new species

Male.—Like *mongol* except that the pollen of the head is grayish-yellow, not golden; the face has a less distinct carina, the antennae closer together at base, and the genitalia are different. The inner forceps are distinctly separated on about the apical half, and the outer ones have expanded tips, about twice as wide as in *mongol.*

Length, 9 mm.

Described from one male collected at Yellow Dragon Gorge, Szechuen Province, China, by Rev. D. C. Graham, in altitude above 12,000 feet.

Type.—Male, Cat. No. 29164, U.S.N.M.

LISPOPAREA, new genus

Allied to *Pollenia*, but has bare parafacials, vibrissae not so close together, facial carina low and rounded except just between bases of antennae, and bend of fourth vein in form of a gentle curve. The thorax has the same covering of deciduous yellow hair as in *Pollenia.* Differs from *Xanthotryxus* in the course of the fourth vein, and in having the facial carina less prominent. The sole species is pale yellow except mesonotum, and more slender than either of the

genera mentioned, having a very different appearance. Runs to *Anthracomyia* new genus in Malloch's Key,[1] but that genus has none of the short silky thoracic hair characteristic of *Pollenia*.

Genotype.—*Lispoparea flava*, new species.

LISPOPAREA FLAVA, new species

Male.—Wholly yellow except the following parts: Mesonotum (except narrow sides), metanotum, and apical part of tarsi. Eyes almost contiguous on front, separated by less than width of anterior ocellus, then diverging rapidly to their lower curve; frontal stripe a broad triangle, disappearing at narrow part of front. No verticals, no reclinate frontals. Ocellars merely hairs; frontals beginning far forward, weak, about 10 in number, barely reaching base of antennae; third antennal joint more than twice the second; arista short, plumose to tip. Palpi rather small, proboscis slightly elongate; cheek two-thirds the eye height. Eyes with distinctly larger facets on upper half or more which gradually diminish downward. Head rather dull yellow but not distinctly pollinose.

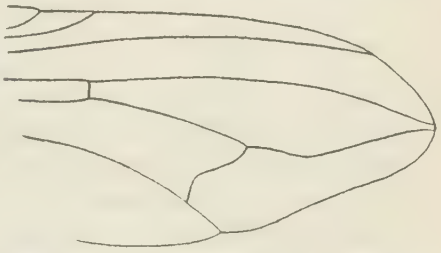

FIGURE 3.—LISPOPAREA FLAVA, NEW SPECIES. APICAL PORTION OF WING (DRAWN BY C. T. GREENE)

Thoracic chaetotaxy: Acrostichal, 1, 1 (?); dorsocentral, 2, 3; humeral, 2; posthumeral, 1; presutural, 1 (far forward as in *Xanthotryxus*); notopleural, 2; supraalar, 2; intraalar, 2; postalar, 2; sternopleural, 1, 1; scutellum with 2 lateral, one equally strong apical. Calypters light yellow. Abdomen wholly pale yellow, subshining, without distinct pollen. Genital segments the same. First segment with marginal bristles only at sides; second, third, and fourth with complete row, no discals. Tarsi gradually brown toward tip. Claws and pulvilli not enlarged; front tibia with one bristle on outer hind side; middle tibia with one on outer front. Wings hyaline with yellow veins; venation as in Figure 3, the fourth vein converging quite gently to third.

Length, 6.6 mm.

Described from one male collected on Mount Omei in Szechuen Province, China, by Rev. D. C. Graham.

Type.—Male, Cat. No. 42878, U.S.N.M.

[1] Proc. Linn. Soc., New South Wales, Vol. 54, 1927, p. 303.

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CATALOGUE OF HUMAN CRANIA IN THE UNITED STATES NATIONAL MUSEUM COLLECTIONS

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INTRODUCTION

THE PUEBLOS

The Pueblo Indians are one of the largest, best defined, and most interesting of the aboriginal American groups. They have been known to the whites since 1539; they are sedentary, mainly agricultural and peaceful people; and while differing in language, they in general show so much in common that they have always been regarded as one large ethnic unit. They extended once over an extensive territory, reaching from westernmost Texas to western Arizona, and from southern Colorado and southeastern Utah to northern Chihuahua in Mexico. They comprised the cliff dwellers of Mesa Verde and other localities, the cliff dwellers being merely Pueblos who lived part of the time in pueblo-like structures built for greater security and other reasons in suitable rock shelters.

In the course of time this territory which once was apparently exclusively Pueblo, though by no means all occupied simultaneously, grew more and more restricted due to abandonment of the marginal as well as unfavorable, or overcome, internal settlements. It thus gradually became flanked and interspersed with abandoned pueblos and was eventually invaded by intruders coming evidently from the far north. These were the Apache, who remain in the region to this day, partly pure, partly admixed into a major contingent of evidently Pueblo derivation as the Navaho.

The total number of the living Pueblo Indians, in 1929, according to the latest data furnished by the Indian Office, was 8,966. They

[1] See also first section of this catalogue on the Mongolians, Eskimo, Aleuts, and Alaska Indians in the Proceedings of the U. S. National Museum, vol. 63, art. 12, published on Mar. 14, 1924. A second section on the Algonkin and related Iroquois, Siouan, Caddoan, Salish and Sahaptin, Shoshonean, and Californian Indians, published in the Proceedings of the U. S. National Museum, vol. 69, art. 5, was issued on May 4, 1927. The third section on Australians, Tasmanians, South African Bushmen, Hottentots, and Negro, published in the Proceedings of the U. S. National Museum, vol. 71, art. 24, was issued on Mar. 5, 1928.

are divided roughly into the Rio Grande Pueblos and Zuñi in New Mexico, and the Hopi in Arizona.

A very large proportion of the old Pueblo territory, particularly in Arizona, contains to-day nothing but ruins. These numerous ruins with their burial grounds, which contain much of interest to archeology, have within the last 50 years been subjected to much excavation. In the course of these excavations many skeletal remains have been recovered. Through bad state of preservation, or inattention, most of such remains have been lost; but important collections have also been saved, especially by the Hemenway, the Hyde, the Kidder Peabody Museum, Cambridge, and the Smithsonian expeditions. These collections are preserved in the Peabody Museum, the American Museum of Natural History, and the United States National Museum. Those in the Peabody Museum, proceeding essentially from the Kidder excavations at Jemez, are being studied by E. A. Hooton. Those in the American Museum comprise a very valuable series of the southern Utah cave dwellers or basket people collected by the Wetherill brothers and Frederick J. Hyde, jr.; these remains have been examined by the writer, who between 1898 and 1903 was in charge of the physical anthropology of the Hyde expeditions and the instructive data are included in this catalogue. The collections at the United States National Museum comprise those by Cushing, Fewkes, Hough, Hodge, Judd, and others, and form the body of the material reported on in this number.

The Pueblo skull is, in general, among the most difficult of study. It is frequently in a poor condition of preservation. The older collections in particular are unsatisfactory in this respect. But the main handicap is artificial deformation. Such deformation was universal in the Pueblo region, though not occurring everywhere with the same frequency or intensity. It consisted everywhere of an occipital compression. Such compression was produced by the child lying bound up in a cradleboard with its head reposing on a resistant, sweet-smelling, grass-filled cushion. It would seem that in some cases the deformation must have been aided in some way, but there is no evidence of any frontal compress or bandages. At all events the deformation which resulted in a higher forehead and higher and broader head, must certainly have been favored. The practice exists to this day among the Pueblos, and they are well aware of the cause and effect.

These with other deformations are the bane of American craniology. They distort the skull so that its natural form is lost or obscured, and they not seldom affect even the base and the face. Mathematical methods for discounting such deformations do not inspire due confidence. Where every skull is deformed we are helpless. Where but one or two of a fair series of skulls show deformation, a strong

suspicion is justified that the undeformed specimens may be extraneous. It is only where the deformations tend to be of minor grade, with a fair proportion of specimens undeformed, or but so slightly or laterally deformed that no general changes have resulted, that there is a chance of a more or less satisfactory study of the series. The best material of this nature is that of old Zuñi, collected most carefully by F. W. Hodge, of the Museum of the American Indian in New York City.

The total number of Pueblo skulls to which this report extends is 645. In addition, there are the data on a small but precious collection of 18 Navaho skulls. The Navaho are one of the largest, still most pure-blooded (so far as white admixture is concerned), and in many respects one of the most interesting tribes, living seminomadically over a great portion of the pueblo region. They speak Athapascan, like the Apache, but in general they neither look nor behave like the latter, wherefore a light on their physical identity is particularly desirable.

The derivation, sex, and nature of the specimens is as follows:

Pueblo (and related)

	Undeformed		Deformed	
	Male	Female	Male	Female
Southern Utah	33	21	4	5
New Mexico:				
Puyé	6	3	17	30
Other Téwa	9	10	17	34
Old Zuñi	34	51	15	18
Miscellaneous	9	5	12	8
Pueblo Bonito and Chaco			11	7
Arizona:				
Salt River	2	4	57	62
Miscellaneous	3	6	33	40
Old Hopi			5	3
Chaves Pass			18	17
Elden			7	6
Petrified Forest			13	6
Colorado			3	1
Total 645 (male 308, female 337)	96	100	212	237
Navaho	7	11		

The skulls have been sexed with all possible care and by repeated examination where doubts existed. In many cases, fortunately, the determination could be controlled by the pelvis and the rest of the skeleton; this applies particularly to the important southern Utah and the old Zuñi material. All the determinations and measurements for the number, except that of the cranial capacity, were made by the

author himself; with the capacity and in the tabulation of the details he was assisted by his aides, T. D. Stewart and M. Goldstein.

The main results are summarized at the end. Those on the deformed skulls, after elimination of all cases where the disturbance had clearly affected also the base or the face, are unexpectedly gratifying. For comparison, finally, there are included abstracts of the data on Shoshonean, Californian, and Apache Tribes, published in the first and second numbers of this catalogue. And there are also added some of the author's as yet unpublished data on the living full-blooded undeformed Pueblos and Navaho, secured in the years 1899–1903.

ABBREVIATIONS

A. M. M.=Army Medical Museum.
A. M. N. H.=American Museum of Natural History.
B. A. E.=Bureau of American Ethnology.
N. G. S.=National Geographic Society.
S. A. A.=School of American Archeology.
U. S. G. S.=United States Geological Survey.

PUEBLOS

UNDEFORMED NEW MEXICO CRANIA.—MALE

PUYÉ

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
269295	E. L. Hewett	Puyé	Adult	Slight lateral	16.2	12.8	12.7	*79.0*	*87.6*	*99.2*	(13.90)	(1,160)		10.8	6.4
262989	do	do	do	Slight occipital	17.1	14.0	13.8	*81.9*	*88.7*	*98.6*	14.97	1,320		10.6	6.8
262961	do	do	45	Slight	16.6	14.0	13.4	*84.3*	*87.6*	*95.7*	14.67	1,355	Slight	11.6	6.9
269292	do	do	Adult	Very slight lateral	16.4	14.0	13.4	*85.4*	*89.3*	*95.7*	14.60	1,365		11.6	6.6
262958	do	do	50	Slight lateral	16.8	14.4	14.4	*85.7*	*92.3*	*100.0*	15.20	1,335	All lost		
263063	do	do	65		15.9	13.8	13.4	*86.8*	*90.2*	*97.1*	(14.37)	[1](1,160)	Medium		6.6
Number of skulls					(6)	(6)	(6)	(6)	(6)	(6)	(4)	(4)		(4)	(5)
Totals					99.0	83.0	81.1				59.44	5,375		44.6	33.3
Averages					*16.5*	*13.83*	*13.52*	*83.84*	*89.12*	*97.71*	*14.86*	*1,344*		*11.15*	*6.66*
Minima					15.9	12.8	12.7	*79.0*	*87.6*	*95.7*	14.60	1,320		10.6	6.4
Maxima					17.1	14.4	14.4	*86.8*	*92.3*	*100.0*	15.20	1,365		11.6	6.9

PUYÉ (INTRUSIVE)

263068	E. L. Hewett	Puyé	65		18.2	13.2	14.0	*72.5*	*89.2*	*106.1*	15.13	1,390	Considerable		7.4

OTHER TÉWA AND MISCELLANEOUS

243512	D. N. Couch	Near Durango	35		18.2	13.2	13.4	*72.5*	*85.4*	*101.5*	14.93	1,400	Moderate		7.5
243507	Cope and Yarrow	Near Santa Fe	70		18.2	13.2	13.7	*72.5*	*87.3*	*103.8*	15.03	1,405	All lost		
225060	C. Carvello	Gran Quivira	65		18.0	13.5	13.0	*75.0*	*82.5*	*96.3*	14.83	1,360	do		[2]7.6
243509	W. S. Wood	Near Fort Union	45	Slight lateral	18.2	14	13.8	*76.9*	*85.7*	*98.6*	15.33	1,550	Moderate		8.2
215426	J. R. De Mier	"New Mexico"	65		17.3	13.5	13.1	*78.0*	*85.1*	*97.0*	14.63	1,255	Considerable		6.9

[1] Exceptional males.

[2] Near.

PUEBLOS—Continued

UNDEFORMED NEW MEXICO CRANIA.—MALE—Continued

OTHER TÉWA AND MISCELLANEOUS—Continued

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
229025	E. L. Hewett	Otowi	50	Slight	17.6	13.8	13.5	*78.4*	*86.0*	*97.8*	14.97	1,305			7.4
228917	do	do	Adult		17.0	13.6	12.8	*80.0*	*83.7*	*94.1*	(14.47)	[1] (1,205)			6.8
228908	do	do	do	Slight lateral	16.2	13.2		*81.5*							
271904	B. A. E	Kwasteyukwa	50		17.5	13.8	13.9	*78.9*	*88.8*	*100.7*	15.07	1,290	Moderate	12	7.3
271819	B. A. E. and S. A. A.	do	40		17.4	13.8	13.6	*79.3*	*87.2*	*98.6*	14.93	(1,370)	Slight	12.2	7.5
271815	B. A. E	do	30			13.2	14.2			*107.6*			No wear	12.5	7.3
269243	E. L. Hewett	Giusiwa, Jemez Valley	35		17.2	13.6	13.2	*79.1*	*85.7*	*97.1*	14.67	1,280	Slight	11.8	7.1
269223	do	do	55	Slight lateral	16.7	13.3	13.1	*79.6*	*87.3*	*98.5*	14.37	1,245	Medium	10.6	6.4
269224	do	do	Adult	Very slight lateral	17.8	14.2	14.2	*79.8*	*88.8*	*100.0*	15.40	1,575	Slight	13.0	7.1
286378	J. W. Fewkes, B. A. E.	Mimbres Valley	65		17.8	14.0	13.8	*78.7*	*86.8*	*98.6*	15.20	1,350	Medium	12.4	7.6
286377	do	Lower Mimbres	Adult		16.3	14.6	14.6	*89.6*	*94.5*	*100.0*	15.17	1,440		11.9	7.3
339696	B. I. Staples	Coolidge	65		17.2	13.9	13.9	*80.8*	*89.4*	*100.0*	15.00	1,285	Considerable	11.3	7.4
329846	N. G. S	Kinbenaiola	Adult		17.2	14.3	13.4	*83.1*	*85.1*	*93.7*	14.97	1,250	Medium	11.6	7.0
228234	E. L. Hewett	Tshirege	do	Slight, if any	16.0	14.0		*87.5*							
Number of skulls					(18)	(19)	(17)	(18)	(16)	(17)	(16)	(15)		(10)	(16)
Totals					311.8	260.7	231.2				238.97	20,195		119.3	116.4
Averages					*17.32*	*13.72*	*13.60*	*79.38*	*86.82*	*99.01*	*14.94*	*1,346*		*11.93*	*7.28*
Minima					16.0	13.2	12.8	72.5	82.5	93.7	14.37	1,205		10.6	6.4
Maxima					18.2	14.6	14.6	*89.6*	*94.5*	*107.6*	15.40	1,575		13.0	8.2

314330	F. W. Hodge	Havikuh	70		18.6	12.7	13.5	*68.3*	*86.3*	*106.3*	14.93	1,310	All lost		[3] 7.8
314328	do	do	50		18.0	12.4	[2] 13.5	*68.9*	*88.3*	*108.9*	14.63	1,210	Slight	12.0	7.1
314311	do	do	Adult.	Slight assymmetry	17.7	12.3	13.4	*69.5*	*89.3*	*108.9*	14.47	1,150		13.1	7.8
308719	do	do	45		18.8	13.3	13.6	*70.7*	*84.7*	*102.3*	15.23		Moderate	12.0	7.3
308676	do	do	40		17.4	12.4	13.6	*71.3*	*91.2*	*109.7*	14.47	1,275	Slight	12.1	6.9
314280	do	do	50		17.4	12.5	12.7	*71.8*	*84.9*	*101.6*	14.20	1,175	do	11.4	6.8
314286	do	do	45		18.6	13.4	12.9	*72.0*	*80.6*	*96.3*	14.97	1,360	do	12.2	7.3
314276	do	do	40		18.4	13.3		*72.3*				(1,365)	do	12.2	7.4
314300	do	do	60		18.2	13.2	13.4	*72.5*	*85.4*	*101.5*	14.93	1,315	Considerable	11.7	7.5
314281	do	do	30		17.6	12.8	High.	*72.7*				1,320	No wear	12.3	7.4
317335	do	do	60		18.4	13.5	13.3	*73.4*	*83.4*	*98.5*	15.07	1,375	Medium	12.5	7.7
308602	do	do	55		17.2	12.9	13.1	*75.0*	*87.0*	*101.6*	14.40	1,330	Moderate	11.7	[2] 7.0
314277	do	do	30		17.0	12.8	13.1	*75.3*	*87.9*	*102.3*	14.30	1,145	No wear	11.7	6.8
314278	do	do	30		17.8	13.5	13.1	*75.8*	*83.7*	*97.0*	14.80	1,270	do	11.9	7.2
308601	do	do	30		17.4	13.2	13.0	*75.9*	*84.4*	*98.5*	14.53	1,320	Slight	11.7	7.1
308603	do	do	50		18.0	13.7	14.2	*76.1*	*89.6*	*103.7*	15.30	1,390	do	[2] 12.9	7.8
308736	do	do	35		18.1	13.8	14.0	*76.2*	*87.8*	*101.5*	15.30	1,460	Very slight	13.4	8.1
308653	do	do	70	Very slight	17.3	13.2	13.1	*76.3*	*85.9*	*99.2*	14.53	1,255	All lost		
314285	do	do	30	Slight lateral	17.2	13.2	13.0	*76.7*	*85.5*	*98.5*	14.47	1,250	No wear	12.3	7.4
314327	do	do	50		17.4	13.4	13.6	*77.0*	*88.3*	*101.5*	14.80		Slight to moderate.	12.3	[2] 7.8
308680	do	do	60		17.4	13.4	[2] 13.8	*77.0*	*89.6*	*103.0*	14.87		Medium		7.6
308721	do	do	50		17.1	13.2	13.6	*77.2*	*89.8*	*103.0*	14.63	1,285	Moderate	11.3	7.0
308627	do	do	50		18.0	13.9	13.8	*77.2*	*86.5*	*99.3*	15.23	1,405	Slight	12.5	7.5
308677	do	do	50		16.8	13.0	13.4	*77.4*	*89.9*	*103.1*	14.40	1,275	Moderate	12.4	7.4
308742	do	do	45		17.8	13.8	12.8	*77.5*	*81.0*	*92.8*	14.80	1,280	do	12.4	7.5
308610	do	do	45		17.1	13.3	13.0	*77.8*	*85.5*	*97.7*	14.47	(1,265)	Moderate		6.6
308745	do	do	40	Slight	17.0	[2] 13.4	High.	*78.8*				[1] 1,270	Slight	12.4	7.5
308688	do	do	Adult.	Slight occipital compression.	17.2	13.6		*79.1*				(1,380)			
308620	do	do	45	Slight lateral	16.8	13.4	13.2	*79.8*	*87.4*	*98.5*	14.47	1,260	Slight	11.6	6.9
314298	do	do	25		17.2	13.8	13.0	*80.2*	*83.9*	*94.2*	14.67	(1,365)	No wear	12.1	7.2
308605	do	do	Adult.		(16.6)	13.6		*(81.9)*							
308623	do	do	do	Very slight occipital compression.	17.5	14.4	13.6	*82.3*	*85.3*	*94.4*	15.17	1,470	Moderate	12.6	7.4
308715	do	do	do		17.0	14.0	13.1	*82.4*	*84.5*	*93.6*	14.70	1,365	do	12.2	7.5
314301	do	do	30		17.0	[2] 14.2	[2] 13.2	*83.5*	*84.6*	*93.0*	14.80	(1,280)	No wear	12.8	7.4
308638	do	do	Adult.	Slight occipital compression.	17.2	14.5	14.0	*84.3*	*88.3*	*96.6*	15.23	[2] 1,450		11.8	7.0
Number of skulls					(34)	(35)	(30)	*(34)*	*(30)*	*(30)*	(30)	(21)		(29)	(32)
Totals					597.6	467.0	400.6				442.77	35,235		353.5	234.7
Averages					*17.58*	*13.34*	*13.35*	*75.87*	*86.36*	*100.07*	*14.76*	*1,305*		*12.19*	*7.83*
Minima					16.8	12.3	12.7	*68.3*	*80.6*	*92.8*	14.20	1,145		11.3	6.6
Maxima					18.8	14.5	14.2	*84.3*	*91.2*	*109.7*	15.30	1,470		13.4	8.1

[1] Exceptional males.

[2] Near.

PUEBLOS—Continued

UNDEFORMED NEW MEXICO CRANIA.—MALE—Continued

PUYÉ

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length, maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
269295	------	------	------	9.3	8.4	9.9	76°	55°	3.2	------	3.8	------	*84.2*	------	4.7	2.6	*55.3*	5.2	6.3	*82.5*	3.1
262989	13.1	*80.9*	*51.9*	9.8	9.0	10.0	71	63	3.4	3.35	3.8	3.6	*89.5*	*93.1*	4.5	2.3	*51.1*	------	------	------	3.1
262961	14.1	*82.3*	*48.9*	10.1	8.8	9.8	68	48	------	3.5	------	3.7	------	*94.6*	5.0	2.6	*52*	5.6	6.4	*87.5*	3.2
269292	13.6	*85.3*	*48.5*	9.8	8.7	10.0	72	50	3.3	3.5	3.7	3.5	*89.2*	*100.0*	4.8	2.5	*52.1*	5.2	6.1	*85.2*	3.3
262958	------	------	------	------	------	10.4	------	------	------	------	------	------	------	------	------	------	------	------	------	------	3.5
263063	------	------	------	9.7	8.6	9.9	72	50	3.6	3.45	3.8	3.8	*94.7*	*90.8*	4.9	2.55	*52.0*	5.1	6.5	*78.5*	------
Number of skulls	(3)	(3)	(3)	(5)	(5)	(6)	(5)	(5)	(4)	(4)	(4)	(4)	(4)	(4)	(5)	(5)	(5)	(4)	(4)	(4)	(5)
Totals	40.8	------	------	48.7	43.5	60	------	------	13.5	13.8	15.1	14.6	------	------	23.9	12.55	------	21.1	25.3	------	16.2
Averages	*13.6*	*82.84*	*49.75*	*9.74*	*8.7*	*10*	*72*	*54*	*3.38*	*3.45*	*3.78*	*3.65*	*89.40*	*94.52*	*4.78*	*2.51*	*52.51*	*5.28*	*6.33*	*83.39*	*3.24*
Minima	13.1	*80.9*	*48.5*	9.3	8.4	9.8	68	48	3.2	3.35	3.7	3.5	*84.2*	*90.8*	4.5	2.3	*51.1*	5.1	6.1	*78.5*	3.1
Maxima	14.1	*85.3*	*51.9*	10.1	9.0	10.4	76	63	3.6	3.5	3.8	3.8	*94.7*	*100*	5.0	2.6	*55.3*	5.6	6.5	*87.5*	3.5

PUYÉ (INTRUSIVE)

263068	[2] 13.9	------	*53.2*	9.7	8.7	10.2	72	58	------	------	------	------	------	------	5.2	2.7	*51.9*	------	------	------	3.65

OTHER TÉWA AND MISCELLANEOUS

243512	13.7	------	*54.7*	10.1	8.8	10.6	72	49	3.85	3.85	4.1	4.1	*93.9*	*93.9*	5.5	2.6	*47.3*	5.6	6.8	*82.4*	------
243507	13.1	------	------	------	9.0	10.6	------	------	3.3	3.4	4.0	3.9	*82.5*	*87.2*	5.55	2.95	*53.2*	------	------	------	------
225060	14.3	------	*53.1*	------	8.8	10.2	------	------	3.35	3.45	3.9	3.8	*85.9*	*90.8*	5.05	2.45	*48.5*	------	------	------	------
243509	13.8	------	*59.4*	10.4	9.2	10.5	68	59	3.8	3.75	3.9	3.8	*97.4*	*98.7*	5.3	2.6	*49.1*	5.9	7.6	*77.6*	------
215426	12.9	------	*53.5*	9.7	8.4	9.7	69	49	3.25	3.2	3.7	3.6	*87.8*	*88.9*	4.8	1.9	*39.6*	5.2	6.1	*85.3*	------

229025	13.9		*53.2*	9.7	8.4	9.8	68	48	3.75	3.6	3.8	3.7	*93.7*	*97.3*	5.3	2.4	*45.3*	5.4	[2]6.4	*84.4*	
228917	13.8		*49.3*	10.4	9.0	10.0	67	43	3.5	3.35	3.8	3.7	*92.1*	*90.5*	5.0	3.0	*60.0*	[2]5.3	6.6	*80.3*	
228908	[2]12.5									3.7		3.5		*105.7*							3.4
271904	13.8	*87.0*	*52.9*	10.2	8.8	10.0	67	54	3.4	3.35	3.65	3.6	*93.2*	*93.1*	4.55	2.5	*54.9*	5.6	6.5	*86.2*	3.6
271819	14.4	*84.7*	*52.1*	9.9	8.6	10.2	70	53	3.4	3.4	4.0	4.0	*85.0*	*85.0*	5.2	2.55	*49.0*	5.7	6.6	*86.4*	3.3
271815	13.3	*94.0*	*54.9*	9.9	8.4	10.2	71	43	3.7	3.8	3.8	3.7	*97.4*	*102.7*	5.4	2.75	*50.9*	5.5	7.2	*76.4*	3.6
269243	13.6	*86.8*	*52.2*	9.6	8.3	9.6	69	53	3.5	3.45	3.9	3.7	*89.7*	*93.2*	4.75	2.4	*50.5*	5.6	6.8	*82.4*	3.6
269223	13.0	*81.5*	*49.2*	10.1	8.6	9.6	67	44	3.15	3.1	3.6	3.6	*87.5*	*86.1*	4.45	2.7	*60.7*	5.6	[2]6.5	*86.2*	[2]3.3
269224															5.0	2.4	*48.0*				3.3
286378	14.6	*84.9*	*52.1*	10.7	9.3	10.7	70	52	3.25	3.25	3.9	3.9	*83.3*	*83.3*	5.2	3.0	*57.7*	5.7	[2]7.0	*81.4*	3.9
286377	14.2	*83.8*	*51.4*	10.4	8.8	10.1	67	44	3.2	3.2	3.9	3.8	*82.1*	*84.2*	5.1	2.8	*54.9*	5.9	7.0	*84.3*	3.7
339696	14.1	*80.1*	*52.5*	10.3	8.8	10.4	70	48	3.5	3.5	3.9	3.9	*89.7*	*89.7*	5.2	2.65	*51.0*	5.7	[2]6.6	*86.4*	[2]3.6
329846	14.1	*82.3*	*49.6*	9.5	8.2	9.9	72	53	3.3	3.2	3.8	3.8	*86.8*	*84.2*	4.7	2.1	*44.7*	5.4	[2]6.0	*90.0*	3.6
228234																					
Number of skulls	(17)	(9)	(15)	(14)	(16)	(16)	(14)	(14)	(16)	(17)	(16)	(17)	(16)	(17)	(17)	(17)	(17)	(13)	(14)	(14)	(11)
Totals	233.1			140.9	139.4	162.1			55.2	58.55	61.65	64.1			86.05	43.75		78.1	93.7		38.9
Averages	*13.71*	*84.97*	*52.67*	*10.06*	*8.71*	*10.13*	*69*	*50*	*3.45*	*3.44*	*3.85*	*3.77*	*89.54*	*91.34*	*5.06*	*2.57*	*50.84*	*5.58*	*6.69*	*83.35*	*3.54*
Minima	12.5	*80.1*	*49.2*	9.5	8.2	9.6	67	43	3.15	3.1	3.6	3.5	*82.1*	*83.3*	4.45	1.9	*39.6*	5.2	6.0	*76.4*	3.3
Maxima	14.6	*94.0*	*59.4*	10.7	9.3	10.7	72	59	3.85	3.85	4.1	4.1	*98.7*	*105.7*	5.55	3.0	*60.7*	5.9	7.6	*90.0*	3.9

OLD ZUÑI

314330	13.8		*56.5*		8.8	10.2			3.55	3.65	3.9	3.9	*91.0*	*93.6*	5.25	2.55	*48.6*				
314328	13.3	*90.2*	*53.4*	10.2	9.4	10.6	73	61	3.5	3.5	3.8	3.8	*92.1*	*92.1*	5.1	2.65	52.0	5.1	6.2	*82.8*	3.35
314311	13.1	*100.0*	*59.5*						3.6	3.8	3.9	3.8	*92.3*	*100.0*	5.6	2.6	*46.4*	5.7	6.4	*89.1*	4.3
308719	13.9	*86.3*	*52.5*	11.4	9.9	11.0	68	47		3.45		3.8		*90.8*	5.1	2.4	*47.1*	5.9	7.1	*83.1*	3.85
308676	13.5	*89.6*	*51.1*	9.0	8.2	9.8	75	61	3.5	3.45	3.7	3.7	*94.6*	*93.2*	4.95	2.5	*50.5*	5.0	6.2	*80.6*	3.6
314280	[2]13.1	*87.0*	*51.9*	9.6	8.1	9.6	69	46	[2]3.3	[2]3.4	3.8	3.8	*86.8*	*89.5*	4.65	2.5	*53.8*	5.3	5.9	*89.8*	3.4
314286	13.5	*90.4*	*54.1*	10.1	8.7	10.0	68	48	3.55	3.55	3.8	3.8	*93.4*	*93.4*	5.15	2.65	*51.5*	5.5	[2]6.7	*82.1*	3.6
314276	[2]13.5	*90.4*	*54.8*						3.4		4.1		*82.9*		4.9	2.2	*44.9*	5.8	6.5	*89.2*	3.7
314300	[2]14.0	*83.6*	*53.6*	10.1	8.8	10.2	69	52	3.45	3.45	4.05	3.85	*85.2*	*89.6*	5.1	2.7	*52.9*				3.7
314281	12.9	*95.3*	*57.4*						[3]3.3	3.35	3.85	3.7	*85.7*	*90.5*	5.3	2.3	*43.4*	5.3	6.8	*77.9*	
317335	13.4	*98.3*	*57.5*	9.7	8.5	9.8	67	55	3.4	3.45	3.9	3.85	*87.2*	*89.6*	5.1	2.6	*51.0*	5.5	6.7	*82.1*	4.1
308602	13.4	*87.3*	*52.2*		7.9	9.8			3.7	3.7	3.9	3.9	*94.9*	*94.9*	5.1	2.45	*48.0*				3.1
314277	13.0	*90.0*	*52.3*	9.3	8.0	9.4	70	48	3.3	3.25	3.7	3.8	*89.2*	*85.5*	4.9	2.4	*49.0*	5.5	6.1	*90.2*	3.9
314278	13.1	*90.8*	*55.0*	9.7	8.5	10.0	71	52	3.7	3.7	3.6	3.7	*102.8*	*100.0*	5.2	2.3	*44.2*	5.4	6.3	*85.7*	3.5
308601	13.4	*87.3*	*53.0*	9.4	8.2	9.7	71	50	3.5	3.6	3.9	3.8	*89.7*	*94.7*	5.25	2.7	*51.4*	5.1	6.4	*79.7*	3.2
308603	13.6	*94.9*	*57.4*	9 8	8.6	10.2	70	57	3.5	3.5	3.7	3.5	*94.6*	*100.0*	5.25	2.25	*42.9*				[2]3.8
308736	13.1	*102.3*	*61.8*	10.7	8.9	10.3	65	49	3.6	3.6	3.95	3.9	*91.1*	*92.3*	5.15	2.4	*46.6*	5.9	6.7	*88.1*	4.1
308653						9.7				3.35		3.9		*85.9*							

[2] Near.

PUEBLOS—Continued

UNDEFORMED NEW MEXICO CRANIA.—MALE—Continued

OLD ZUÑI—Continued

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion-Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
							°	°													
314285	12.9	*95.3*	*57.4*	9.9	8.4	9.4	65	50	3.35	3.45	3.75	3.6	*89.3*	*95.8*	4.9	2.55	*52.0*	5.5	6.2	*88.7*	3.6
314327	[2] 13.6	*90.4*	*57.4*												5.3	2.5	*47.2*	5.7	[2] 6.1	*93.4*	3.3
308680						9.9			3.4		3.75		*90.7*		5.4	2.8	*51.9*				4.05
308721	13.2	*85.6*	*53.0*	9.5	8.2	9.8	71	52	3.6	3.45	3.8	3.8	*94.7*	*90.8*	4.7	2.5	*53.2*	5.4	6.7	*80.6*	3.4
308627	14.0	*89.3*	*53.6*	10.4	9.2	10.7	72	56	3.65	3.65	4.0	4.1	*91.3*	*89.0*	5.2	2.3	*44.2*	5.7	6.5	*87.7*	3.8
308677	13.3	*93.2*	*55.6*	9.5	8.5	10.2	73	60	3.45	3.4	3.7	3.8	*93.2*	*89.5*	5.0	2.45	*49.0*	5.4	6.4	*84.4*	3.75
308742	13.8	*89.9*	*54.3*	9.6	8.1	9.2	64	44	3.6	3.6	3.8	3.8	*94.7*	*94.7*	5.45	2.7	*49.5*	5.5	6.4	*85.9*	3.7
308610	13.8		*47.8*	8.6	7.7	9.4	76	60	3.3	3.2	3.6	3.6	*91.7*	*88.9*	4.6	2.35	*51.1*	4.8	6.6	*72.7*	
308745	13.5	*91.9*	*55.6*						3.45	3.55	3.9	3.8	*88.5*	*93.4*	5.0	2.6	*52.0*	5.6	6.7	*83.6*	3.8
308688																					
308620	13.3	*87.2*	*51.9*	9.9	8.6	9.8	69	51	3.5	3.45	3.95	3.85	*88.6*	*89.6*	4.75	2.65	*55.8*	5.7	6.6	*86.4*	3.5
314298	13.1	*92.4*	*55.0*	9.6	8.1	9.8	70	49	3.25	3.2	3.35	3.4	*97.0*	*94.1*	4.95	2.4	*48.5*	5.1	6.1	*83.6*	3.5
308605	12.5																				3.4
308623				9.8	8.6	9.8	68	51	3.5	3.5	3.7	3.75	*94.6*	*93.3*	5.3	2.6	*49.1*	5.3	6.6	*80.3*	3.6
308715	13.5	*90.4*	*55.6*	9.4	8.3	9.8	70	55	3.75	(3.9)	3.7	(3.55)	*101.4*	*(109.9)*	5.3	2.6	*49.1*	5.1	6.2	*82.3*	3.6
314301	14.5	*88.3*	*51.0*						3.45	3.55	3.7	3.7	*93.2*	*95.9*	5.25	2.65	*50.5*	5.3	7.1	*74.6*	3.7
308638	14.2	*83.1*	*49.3*	10.2	9.0	10.5	72	52	3.35	3.6	3.8	4.0	*88.2*	*90.0*	5.0	2.7	*54.0*	5.3	6.6	*80.3*	3.7
Number of skulls	(31)	(28)	(30)	(23)	(25)	(27)	(23)	(23)	(30)	(30)	(30)	(30)	(30)	(30)	(32)	(32)	(32)	(27)	(27)	(27)	(30)
Totals	416.8			225.4	213.2	268.6			104.45	105.25	114.05	113.25			163.15	80.5		146.4	174.8		109.6
Averages	*13.45*	*90.49*	*54.84*	*9.80*	*8.53*	*9.95*	*70*	*52*	*3.48*	*3.51*	*3.80*	*3.78*	*91.58*	*92.94*	*5.10*	*2.52*	*49.84*	*5.42*	*6.47*	*83.75*	*3.65*
Minima	12.5	*83.1*	*47.8*	8.6	7.7	9.2	64	44	3.25	3.2	3.35	3.4	*82.9*	*85.5*	4.6	2.2	*42.9*	4.8	5.9	*72.7*	3.1
Maxima	14.5	*102.3*	*61.8*	11.4	9.9	11.0	76	61	3.75	3.9	4.1	4.1	*102.8*	*109.9*	5.6	2.8	*55.8*	5.9	7.1	*93.4*	4.3

PUEBLOS—Continued

UNDEFORMED ARIZONA CRANIA.—MALE

SALT RIVER AND MISCELLANEOUS

Catalogue No.	Collection	Location	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
239624	Hemenway Exp.	Salt River	Adult	Slight lateral occipital compression.	19.2	14.4	------	*75.0*	------	------	------	1,560	------	------	------
239325	----do----	----do----	----do----	------	18.6	14.1	13.8	*75.8*	*84.4*	*97.9*	15.50	1,455	------	------	------
[3] 213288	W. Hough	McDonald's Canyon	35	------	(16.8)	(12.6)	(13.8)	(*75.0*)	(*93.9*)	(*109.5*)	14.40	[4] (1,200)	------	------	(7.0)
[3] 213294	----do----	----do----	60	------	17.0	14.3	13.8	*84.1*	*88.2*	*96.5*	15.03	(1,315)	All lost	------	[2] 7.7
[2] 305484	W. Hough	Near Holbrook	24	Slight, if any	16.6	13.8	13.4	*83.1*	*88.2*	*97.1*	14.60	1,310	No wear	12.0	7.2
177872	J. W. Fewkes	Four-Mile Canyon	65	------	16.7	14.2	------	*85.0*	------	------	------	------	All lost	------	------
Number of skulls					(5)	(5)	(4)	(*5*)	(*3*)	(*3*)	(4)	(3)		(1)	(3)
Totals					88.1	70.8	54.8	------	------	------	59.53	4,325		12.0	21.9
Averages					*17.62*	*14.16*	*13.70*	*80.4*	*86.9*	*97.2*	*14.88*	*1,442*		*12.0*	*7.30*
Minima					16.6	13.8	13.4	*75.0*	84.4	96.5	14.40	1,310		12.0	7.0
Maxima					19.2	14.4	13.8	*85.0*	88.2	*97.9*	15.50	1,560		12.0	7.7

[2] Near.

[3] Unquestionably male; skull nonpathological, but rather thick

[4] Possibly of a mental subnormal.

PUEBLOS—Continued

UNDEFORMED ARIZONA CRANIA.—MALE—Continued

SALT RIVER AND MISCELLANEOUS—Continued

Catalogue No.	Diam. Bizygomatic Maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Ft.	Basion Subnasal Ft.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
							°	°													
239624																					
239325						10.3			3.25		3.9		83.3								
[3] 213288	(13.5)		*(51.9)*	10.3	9.1	10.2	69	51	3.35	3.2	3.65	3.75	*91.8*	*85.2*	5.0	2.7	*54.0*	5.5	6.2	*83.7*	
[3] 213294	13.2		*58.3*		9.2	10.3			3.6	3.55	3.8	3.8	*94.7*	*93.4*	5.2	2.5	*48.1*				
[3] 305484	12.7	*94.5*	*56.7*	8.8	7.4	9.2	69	48	3.65	3.65	3.55	3.55	*102.8*	*102.8*	5.0	2.4	*48.0*	5.2	6.4	*81.3*	3.4
177872									3.3	3.35	4.0	3.95	*82.5*	*84.8*	5.1	2.5	*49.0*				
Number of skulls	(3)	*(1)*	*(3)*	(2)	(3)	(4)	(2)	(2)	(5)	(4)	(5)	(4)	*(5)*	(4)	(4)	(4)	(4)	(2)	(2)	(2)	(1)
Totals	39.4			19.1	25.7	40.0			17.15	13.75	18.9	15.05			20.3	10.1		10.7	12.6		3.4
Averages	*13.13*	*94.49*	*55.58*	*9.55*	*8.57*	*10.00*	*70*	*50*	*3.43*	*3.44*	*3.78*	*3.76*	*90.74*	*91.36*	*5.08*	*2.53*	*49.75*	*5.35*	*6.30*	*84.92*	*3.4*
Minima	12.7	*94.5*	*51.9*	8.8	7.4	9.2	69	48	3.25	3.2	3.55	3.55	*82.5*	*84.8*	5.0	2.4	*48.0*	5.2	6.2	*81.3*	3.4
Maxima	13.5	*94.5*	*58.3*	10.3	9.1	10.3	69	51	3.65	3.65	4.0	3.95	*102.8*	*102.8*	5.2	2.7	*54.0*	5.5	6.4	*88.7*	3.4

[3] Unquestionably male; skull nonpathological, but rather thick.

UNDEFORMED NEW MEXICO CRANIA.—FEMALE

PUYÉ

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
269259	E. L. Hewett	Puye	55		16.7	13.6	13.3	*81.4*	*87.8*	*97.8*	14.53	1,220	Medium	10.9	6.7
269278	do	do	65	Slight	16.7	13.7	13.2	*82.0*	*86.8*	*96.4*	14.53	1,300	do		7.1
263050	do	do	25	do	15.5	13.6	12.2	*87.7*	*83.8*	*89.7*	13.77	1,150			
Number of skulls					(3)	(3)	(3)	*(3)*	*(3)*	*(3)*	(3)	(3)		(1)	(2)
Totals					48.9	40.9	38.7				41.83	3,670		10.9	13.8
Averages					*16.3*	*13.63*	*12.9*	*83.64*	*86.19*	*94.62*	*14.28*	*1,223*		*10.9*	*6.9*
Minima					15.5	13.6	12.2	*81.4*	*83.8*	*89.7*	13.77	1,150			6.7
Maxima					16.7	13.7	13.3	*87.7*	*87.8*	*97.8*	14.53	1,300			7.1

PUYÉ (INTRUSIVE)

262997	E. L. Hewett	Puye	35		17.6	12.4	High.	*70.5*				1,190	Very slight	10.9	6.7
262926	do	do	30		16.4	12.2	12.2	*74.4*	*85.3*	*100*	13.60	(1,090)	do	11.0	6.8

PUEBLOS—Continued

UNDEFORMED NEW MEXICO CRANIA.—FEMALE—Continued

PUYÉ

Catalogue No.	Diam. Bizygomatic maxim. (c)	Facial Index, total $\left(\frac{a \times 100}{c}\right)$	Facial Index, upper $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion-Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	Orbital Index, right	Orbital Index, left	Nose, height	Nose, breadth maxim.	Nasal index	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	Upper Alveolar Arch, Index	Lower Jaw, height at Symphysis
269259	13.2	*82.6*	*50.8*	10.2	8.8	10.2	71°	48°	3.3	3.35	3.8	3.65	*86.8*	*91.8*	4.6	2.5	*54.3*	5.3	6.5	*81.5*	3.3
269278	13.9		*51.1*	10.2	8.4	9.6	65	40	3.5	3.5	3.9	3.9	*89.7*	*89.7*	4.9	2.55	*52.0*				3.9
263050						8.8															2.9
Number of skulls	(2)	(1)	(2)	(2)	(2)	(3)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	(1)	(1)	(3)
Totals	27.1			20.4	17.2	28.6			6.8	6.85	7.7	7.55			9.5	5.05		5.3	6.5		10.1
Averages	*13.55*	*82.58*	*50.92*	*10.2*	*8.6*	*9.53*	*68*	*44*	*3.4*	*3.44*	*3.85*	*3.78*	*88.27*	*90.75*	*4.75*	*2.53*	*53.16*	*5.3*	*6.5*	*81.54*	*3.37*
Minima	13.2		*50.8*	10.2	8.4	8.8	65	40	3.3	3.35	3.8	3.65	*86.8*	*89.7*	4.6	2.5	*52.0*				2.9
Maxima	13.9		*51.1*	10.2	8.8	10.2	71	48	3.5	3.5	3.9	3.9	*89.7*	*91.8*	4.9	2.55	*54.3*				3.9

PUYÉ (INTRUSIVE)

262997	Narrow								3.8	3.8	3.7	3.7	*102.7*	*102.7*	5.0	2.4	*48*	5.3	5.7	*93.0*	3.0
262926	12.1	*90.9*	*56.2*	9.0	7.6	8.8	66	46	3.45	3.45	3.7	3.6	*93.2*	*95.8*	4.75	2.3	*48.4*	5.1	6.2	*82.3*	3.1

OTHER TÉWA AND MISCELLANEOUS

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	Cranial Index	Mean Height Index	Height-Breadth Index	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion Height (a)	Alveol. Pt.-Nasion Height (b)
269238	E. L. Hewett	Giusiwa, Jemez Valley	25		17.8	[2] 12.0		*67.4*					All lost		
269214	do	do	25		16.8	13.3	12.6	*73.2*	*86.6*	*102.4*	13.90	1,205	No wear	11.3	6.8
271911	B.A.E. and S.A.A.	Kwasteyukwa	40		18.5	13.8	13.1	*74.6*	*81.1*	*94.9*	15.13	(1,330)			

271917	do	do	60		16.8	13.0	12.5	77.4	83.9	96.2	14.10					
271867	do	do			16.9	13.4	13.2	79.3	87.1	98.5	14.50	1,215	Medium	11.5	7.2	
271918	do	do	35	Slight lateral	16.4	13.1	12.7	79.9	89.1	96.9	14.07		Moderate	9.9	6.3	
271865	do	do	70	Very slight	16.0	13.6	13.0	85.0	87.8	95.6	14.20	1,190	Considerable		6.9	
271891	do	do	55	Slight, if any	15.9	13.7	12.7	86.2	85.8	92.7	14.10				7.2	
271860	do	do	Adult									1,075	Considerable		6.4	
228930	do	Otowi, Pajarito Pk	30	Slight	16.4	13.9	13.5	84.8	89.1	97.1	14.60	1,330			7.0	
201287	F. X. Shulack, U. S. G. S.	White Mt	60		17.3	13.3	12.0	76.9	78.4	90.2	14.20	1,230			6.2	
243524	E. W. Nelson	Tulerosa	24		16.3	13.0	13.7	79.8	93.5	105.4	14.33	1,230			[2] 6.7	
246968	W. Hough	do	40	Very slight	15.8	13.4	13.4	84.8	91.8	100.0	14.20	1,175	Slight	10.8	6.9	
228243	E. L. Hewett	Tshirege	60		16.8	13.6	13.4	81.0	88.2	98.5	14.60	1,320	All lost			
340048	N. M. Judd, N. GS.	Chaco Canyon	Adult												6.4	
Number of skulls					(13)	(13)	(12)	(13)	(12)	(12)	(12)	(9)		(4)	(11)	
Totals					217.7	172.1	155.8				171.93	10,970		43.5	74.0	
Averages					*16.75*	*13.24*	*12.98*	*79.05*	*86.56*	*97.31*	*14.33*	*1,219*		*10.88*	*6.73*	
Minima					15.8	12.0	12.0	67.4	78.4	90.2	13.90	1,075		9.9	6.2	
Maxima					18.5	13.9	13.7	86.2	93.5	105.4	15.13	1,330		11.5	7.2	

OLD ZUÑI

308608	F. W. Hodge	Havikuh	Adult		17.7	12.5		70.6				(1151)				
314303	do	do	40		17.4	12.4	13.2	71.3	88.6	106.5	14.33	1230	Slight	11.4	7.2	
314283	do	do	40		17.3	12.6	12.5	72.8	88.6	99.2	14.13	1130	do	11.0	6.4	
308747	do	do	30	Some posthumous	16.4	[2] 12.0	12.5	73.2	88.0	104.2	13.63	1070	Very slight		6.5	
314325	do	do	22		17.6	12.9	12.8	73.3	88.9	99.2	14.43		No wear	11.4	6.6	
308682	do	do	45		17.3	12.9	13.6	74.6	90.1	105.4	14.60	1225	All lost			
308748	do	do	30		17.1	12.9	12.8	75.4	85.3	99.2	14.27	1225	No wear		6.4	
314324	do	do	35		17.5	13.2	12.4	75.4	80.8	98.9	14.37	1220	Slight	12.0	7.4	
317336	do	do	25		16.6	12.6	12.4	75.9	84.9	98.4	13.87	1115	Very slight	11.4	6.6	
314331	do	do	40		17.6	13.4	13.4	76.1	86.5	100.0	14.80	1340	No wear	10.9	6.5	
308650	do	do	50		16.3	12.4	12.6	76.1	87.8	101.6	13.77	1110	Slight	10.6	6.3	
308744	do	do	35		17.4	13.3	12.8	76.4	83.4	96.2	14.50	1250	Very slight	12.3	7.1	
308615	do	do	35		16.8	12.9	12.4	76.8	83.5	96.1	14.03	1220	do	11.4	6.6	
308619	do	do	50		16.7	13.0	13.2	77.8	88.9	101.5	14.30	(1260)	Slight	11.3	7.0	
308617	do	do	35		16.8	13.1		78.0				(1235)	Very slight		7.5	
314316	do	do	55		16.4	12.8	12.5	78.1	85.6	97.7	13.90	1110	Slight (but early loss of all in front)			
314287	do	do	35		16.6	13.0	12.3	78.3	88.1	94.6	13.97	1175	Slight	10.6	6.3	
308749	do	do	24		17.1	13.4	13.3	78.4	87.2	99.3	14.60	1305	No wear	11.6	6.8	
314323	do	do	30		16.9	13.3	13.3	78.7	88.1	100.0	14.50	(1255)	Very slight	11.2	6.9	
308711	do	do	Adult		16.5	13.0	12.6	78.8	85.4	96.9	14.03	1130				
308746	do	do	30		16.7	13.2	13.4	79.0	89.6	101.5	14.43	1225	No wear	11.7	7.3	
308733	do	do	26	Slight lateral	16.6	13.2	12.7	79.5	85.2	96.2	14.17	1265	do	11.2	6.5	
308634	do	do	Adult		16.0	12.8	12.8	80.0	88.9	100.0	13.87	1125	Moderate	11.9	7.2	
308753	do	do	Young adult	Slight lateral	15.8	12.7	12.1	80.4	84.9	95.3	13.53	1135		10.2	6.1	
308750	do	do	Adult		17.0	13.7	13.2	80.6	86.0	96.4	14.63	1180	Medium	11.8	7.4	
308740	do	do	30		15.7	12.7	12.9	80.6	90.8	101.6	13.77	1130	No wear	11.2	6.5	

[2] Near.

PUEBLOS—Continued

UNDEFORMED NEW MEXICO CRANIA.—FEMALE—Continued

OLD ZUÑI—Continued

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
308725	E. W. Hodge	Havikuh	30		16.0	13.0	12.0	*81.3*	*82.8*	*92.3*	13.67		Very slight	10.9	6.7
317334	do	do	55	Very slight lateral	16.1	13.1	12.6	*81.4*	*86.3*	*96.2*	13.93	1,075	Moderate	11.4	6.9
314334	do	do	30		16.2	13.2	12.3	*81.5*	*83.7*	*93.2*	13.90				
308621	do	do	60		16.4	13.4	12.6	*81.7*	*84.6*	*94.0*	14.13	1,230	Medium		
308612	do	do	40	Slight	15.8	12.9	12.9	*81.7*	*89.9*	*100.0*	13.87	1,080	Slight	10.8	6.5
314313	do	do	30		15.4	12.6	12.4	*81.8*	*88.6*	*98.4*	13.47	1,030	Very slight	11.6	7.2
308625	do	do	40		16.6	13.6	12.9	*81.9*	*85.4*	*94.9*	14.37	1,260	Slight	11.9	7.2
308629	do	do	65		16.3	13.4	12.6	*82.2*	*84.8*	*94.0*	14.10	1,190	Medium	10.9	7.2
308636	do	do	Adult		16.3	13.4		*82.2*				[2] 1,160	Slight	10.7	6.6
308720	do	do	30		15.8	13.0	13.2	*82.3*	*91.7*	*101.5*	14.00	(1,080)	do		
314305	do	do	35		16.4	13.5	12.4	*82.3*	*82.9*	*91.9*	14.10	1,035	do	12.3	7.4
308604	do	do	Adult		16.4	13.5	12.6	*82.3*	*84.3*	*93.3*	14.17	1,100			
308628	do	do	do	Slight asymmetry	15.8	13.0	13.3	*82.3*	*92.4*	*102.3*	14.03	1,140		11.5	7.0
314332	do	do	25		16.6	13.7	13.6	*82.5*	*89.8*	*99.3*	14.63	1,295	All lost	[2] 11.1	6.2
308685	do	do	35		15.6	12.9	12.7	*82.7*	*89.1*	*98.5*	13.73	1,110	do	11.2	6.6
326192	do	do	55		16.3	13.6	13.1	*83.4*	*87.6*	*96.3*	14.33	1,165		10.9	6.6
308716	do	do	Adult	Slight occipital compression.	(15.9)	(13.4)	(13.5)	(*84.5*)	(*92.2*)	(*100.7*)	14.27	1,300	Medium	11.5	7.3
308674	do	do	50		15.4	13.0	12.8	*84.4*	*90.1*	*98.5*	13.73	1,090	Moderate	11.4	6.7
314302	do	do	45	Slight lateral	15.4	13.0	12.0	*84.4*	*84.5*	*92.3*	13.47	1,025	do	11.0	[2] 6.6
314320	do	do	Adult	Slight occipital compression.	(15.8)	(13.4)	12.7	(*84.8*)	(*87.0*)	(*94.8*)	13.97	1,230			
308708	do	do	35		16.2	13.9	12.3	*85.8*	*81.7*	*88.5*	14.13	1,185	Very slight		6.7
308621	do	do	35	Slight	15.6	13.4	12.8	*85.9*	*88.3*	*95.5*	13.93	1,150	do	11.1	6.6
308718	do	do	40		15.6	13.6	12.5	*87.2*	*85.6*	*91.9*	13.90		All lost		
308734	do	do	50		15.2	13.4	12.6	*88.2*	*88.1*	*94.0*	13.73	1,100	Slight	11.5	6.9
308743	do	do	25	Very slight lateral	15.2	13.4	13.0	*88.2*	*90.9*	*97.0*	13.87	1,080	No wear	11.1	6.8
308739	do	do	25		16.1	14.2	12.9	*88.2*	*85.1*	*90.9*	14.40	1,190	do	12.2	7.5
314310	do	do	75		15.5	[2] 14.0	12.5	*90.3*	*84.7*	*89.3*	14.00		All lost		
Number of skulls					(51)	(51)	(49)	(*51*)	(*48*)	(*48*)	(50)	(43)		(38)	(42)
Totals					836.0	669.6	625				704.26	50,135		430.1	286.3

Averages								*16.39*	*13.13*	*12.76*	*80.10*	*86.50*	*97.10*	*14.09*	*1,166*				*11.32*	*6.8*
Minima								15.2	12.0	12	*70.6*	*80.8*	*88.5*	*13.47*	1,025				10.2	6.1
Maxima								17.7	14.2	13.6	*90.3*	*92.4*	*106.5*	14.80	1,340				12.3	7.5

OTHER TÉWA AND MISCELLANEOUS

Catalogue No.	Diam. Bizygomatic Maxim. (c)	*Facial Index, total* $\left(\frac{\text{aN100}}{\text{c}}\right)$	*Facial Index, upper* $\left(\frac{\text{bN100}}{\text{c}}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
							°	°													
269238																					
269214	13.4	*84.3*	*50.7*	9.7	8.4	9.6	68	47	3.55	3.5	3.9	3.8	*91.0*	*92.1*	4.95	2.8	*56.6*	5.5	6.5	*84.6*	3.5
271911						9.8															3.7
271917	12.4				7.4	8.8			3.5	3.5	3.7	3.75	*94.6*	*93.3*	4.75	2.45	*51.6*				3.1
271867				9.9	8.3	9.6	66	47	3.3	3.25	3.75	3.6	*88.0*	*90.3*	4.85	2.5	*51.5*				3.4
271918	[2] 12.8	*77.3*	*49.2*	9.1	8.2	9.1	70	54		3.4		3.7		*91.9*	4.6	2.25	*48.9*	5.0	6.1	*82.0*	2.6
271865	[2] 13.0		*53.1*	10.1	8.4	9.4	64	42	3.3	3.3	3.6	3.4	*91.7*	*97.1*	4.7	2.55	*54.3*				3.4
271891	[2] 12.6		*57.1*	9.0	7.6	9.0	67	45		3.35		3.75		*89.3*	5.15	2.65	*51.5*				3.2
271860	[2] 12.5		*51.2*			9.4			3.4		3.8		*89.5*		4.8	2.65	*55.2*				
228930	13.0		*53.8*	9.1	7.9	9.5	71	48	3.6	3.55	3.7	3.6	*97.3*	*98.6*	5.2	2.6	*50.0*	5.0	6.0	*83.3*	
201287	13.0		*47.7*	9.4	8.3	9.3	70	43	3.4	3.5	3.8	3.7	*89.5*	*94.6*	4.8	2.5	*52.1*	5.1	5.7	*89.5*	
243521	12.4		*54.0*			10.1			3.5	3.4	3.85	3.8	*90.9*	*89.5*							
246968	13.1	*82.4*	*52.7*	9.4	8.4	9.6	71	53	3.25	3.2	3.85	3.8	*84.4*	*84.2*	5.15	2.75	*53.4*	5.1	6.3	*81.0*	3.0
228243						10.1															
340048	12.3		*52.0*	8.1	7.2	9.2	78	57	3.4	3.5	3.55	3.35	*95.8*	*104.5*	4.6	2.4	*52.2*	4.4	5.9	*74.6*	
Number of skulls	(11)	(5)	(10)	(9)	(10)	(14)	(9)	(9)	(10)	(11)	(10)	(11)	(10)	(11)	(11)	(11)	(11)	(6)	(6)	(6)	(8)
Totals	140.5			83.8	80.1	132.5			34.2	37.45	37.5	40.25			53.55	28.1		30.1	36.5		25.9
Averages	*12.77*	*81.42*	*52.15*	*9.31*	*8.01*	*9.46*	*70*	*48*	*3.42*	*3.40*	*3.75*	*3.66*	*91.20*	*93.04*	*4.87*	*2.55*	*52.47*	*5.02*	*6.08*	*82.47*	*3.24*
Minima	12.3	*77.3*	*47.7*	8.1	7.2	8.8	64	42	3.25	3.2	3.55	3.35	*84.4*	*84.2*	4.6	2.25	*48.9*	4.4	5.7	*74.6*	2.6
Maxima	13.4	*84.3*	*57.1*	10.1	8.4	10.1	78	57	3.6	3.55	3.9	3.8	*97.3*	*104.5*	5.2	2.8	*56.6*	5.5	6.5	*89.5*	3.7

[2] Near.

PUEBLOS—Continued

UNDEFORMED NEW MEXICO CRANIA.—FEMALE—Continued

OLD ZUÑI

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length, maxim.	Upper Alveolar Arch, breadth maxim	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
308608							°	°		3.65		3.6		*101.4*	5.1						3.7
314303	12.8	*89.1*	*56.3*	10.0	8.7	10.0	69	51	3.5	3.5	3.8	3.7	*92.1*	*94.6*	5.0	2.65	*53.0*	5.3	5.9	*89.8*	3.5
314283	[2] 12.8	*85.9*	*50.0*	9.5	8.4	9.7	72	54	3.1	3.0	3.55	3.4	*87.3*	*88.2*	4.5	2.6	*57.8*	5.3	6.0	*88.3*	3.3
308747	12.3		*52.8*	9.6	8.2	9.3	68	48	3.55	3.5	3.6	3.6	*98.6*	*97.2*	4.4	2.35	*53.4*	5.4	6.1	*88.5*	
314325	13.3	*85.7*	*49.6*	9.7	8.5	9.8	71	50	3.35	3.3	3.7	3.9	*90.5*	*84.6*	4.8	2.4	*50.0*	5.2	6.3	*82.5*	3.5
308682	13.3					10.1															
308748	12.6		*50.8*	9.7	8.4	9.6	70	44	3.15	3.15	3.7	3.7	*85.1*	*85.1*	4.7	2.75	*58.5*	5.4	6.3	*85.7*	
314324	[2] 13.0	*92.3*	*56.9*	9.8	8.5	9.8	68	51	3.55	3.55	3.85	3.85	*92.2*	*92.2*	5.2	2.75	*52.9*	5.6	6.6	*84.8*	3.8
317336	12.8	*89.1*	*51.6*	9.5	8.0	9.2	67	46	3.25	3.4	3.6	3.55	*90.3*	*95.8*	4.5	2.4	*53.3*	5.3	5.9	*89.8*	3.5
314331	12.4	*87.9*	*52.4*	9.7	8.8	9.8	71	57	3.1	3.0	3.5	3.45	*88.6*	*87.0*	4.7	2.6	*55.3*	5.5	5.9	*93.2*	3.2
308650	[2] 12.3	*86.2*	*51.2*	9.0	8.3	9.5	74	61	3.55	3.5	3.8	3.7	*93.4*	*94.6*	4.65	2.55	*54.8*	5.0	5.3	*94.3*	3.0
308744	[2] 12.9	*95.3*	*55.0*	9.4	8.2	9.6	70	51	3.4		3.7		*91.9*		5.15	2.6	*50.5*	5.3	6.4	*82.8*	3.7
308615	12.6	*90.5*	*52.4*	9.6	8.3	9.4	68	45	3.5	3.5	3.7	3.6	*94.6*	*97.2*	4.9	2.65	*54.1*	5.3	6.1	*86.9*	3.1
308619	12.3	*91.9*	*56.9*	9.4	8.4	9.5	69	56	3.45	3.45	3.9	3.7	*88.5*	*93.2*	5.05	2.4	*47.5*	5.2	6.3	*82.5*	3.25
308617	[2] 12.9		*58.1*						3.5	3.65	3.9	3.65	*89.7*	*100.0*	5.45	2.45	*45.0*				
314316										3.6		3.8		*94.7*	4.8	[2] 2.6	*54.2*				[2] 3.4
314287	13.1	*89.9*	*48.1*	9.5	8.2	9.2	68	47	3.3	3.3	3.9	3.8	*84.6*	*86.8*	4.4	2.45	*55.7*	5.2	6.4	*81.3*	3.05
308749	12.8	*90.6*	*58.1*	9.5	8.1	9.6	70	48	3.7	3.75	3.9	3.7	*94.9*	*101.4*	4.75	2.4	*50.5*	5.2	6.5	*80.0*	3.4
314323	12.6	*88.9*	*54.8*	10.4	8.7	9.8	66	43	3.35	3.55	3.75	3.6	*89.3*	*98.6*	4.65	2.55	*54.8*	[2] 5.7	[2] 6.2	*91.9*	3.35
308711				9.2																	
308746	13.2	*88.6*	*55.3*	9.8	8.4	9.6	67	52	3.35	3.4	3.9	3.7	*85.9*	*91.9*	4.8	2.6	*54.2*	5.5	6.7	*82.1*	3.45
308733	12.6	*88.9*	*51.6*	9.3	8.1	9.3	69	49	3.35	3.35	3.6	3.5	*93.1*	*95.7*	4.65	2.3	*49.5*	5.1	5.8	*87.9*	3.2
308634	12.5	*95.2*	*57.6*	9.6	8.5	9.7	69	45	3.1	3.1	3.3	3.2	*93.9*	*96.9*	4.9	2.3	*46.9*	5.2	5.6	*92.9*	3.8
308753	11.6	*87.9*	*52.6*	8.9	8.0	8.9	70	53	3.1	3.2	3.5	3.55	*83.6*	*90.1*	4.5	2.3	*51.1*	4.6	5.6	*82.1*	2.8
308750	(12.9)	(*91.5*)	(*57.4*)	9.1	8.2	9.5	70	60	3.7	3.7	4.0	3.8	*92.5*	*97.4*	5.2	2.7	*51.9*	5.5	6.7	*82.1*	3.6
308740	[2] 13.1	*85.5*	*49.6*	10.1	8.4	9.7	68	41	3.4	3.4	3.6	3.6	*94.4*	*94.4*	4.45	2.65	*59.6*	5.5	6.4	*85.9*	3.65
308725						9.0			3.5		3.6		*97.2*		4.35	2.7	*62.1*	5.5	6.2	*88.7*	3.4
317334	12.3	*92.7*	*56.1*	9.4	8.3	9.4	69	52	3.65	3.65	3.6	3.7	*101.4*	*98.6*	5.0	2.55	*51.0*				3.35
314334						10.2															3.3

308624						9.5														
308612	13.2	*81.8*	*49.2*	9.4	8.4	9.6	72	55	3.4	3.5	3.6	3.6	*94.4*	*97.2*	4.7	2.7	*57.4*	5.2	6.3	*82.5*	3.2
314313	13.0	*89.2*	*55.4*	9.7	8.2	9.5	67	46	3.5	3.6	3.7	3.6	*94.6*	*100.0*	5.0	2.6	*52.0*	5.6	6.4	*87.5*	3.7
308625	12.9	*92.2*	*55.8*	9.8	8.5	9.6	67	52	3.4	3.5	3.6	3.5	*94.4*	*100.0*	4.85	2.35	*48.5*	5.7	6.3	*90.5*	3.6
308629	12.9	*84.5*	*55.8*	8.3	7.5	9.2	73	63	3.8	3.75	3.8	3.8	*100.0*	*98.7*	5.05	2.7	*53.5*				[2] 2.9
308636	12.5	*85.6*	*52.8*							3.65		3.6		*101.4*	4.8			5.1			2.9
308720						9.9												5.2	6.0	*86.7*	
314305	13.7	*82.8*	*54.0*	9.4	8.3	9.8	71	55	3.5	3.4	3.75	3.8	*93.3*	*89.5*	5.3	2.6	*49.1*	5.1	6.7	*76.1*	3.7
308604						9.5															3.2
308628				9.4	8.4	9.4	69	58	3.6	3.65	3.75	3.6	*96.0*	*101.4*	4.9	2.5	*51.0*	5.1	6.4	*79.7*	3.4
314332	[2] 12.6	*88.1*	*49.2*	8.7	8.0	9.3	75	59	3.3	3.2	3.5	3.4	*94.3*	*94.1*	4.8	2.35	*49.0*	5.0	5.8	*86.2*	2.8
308685	12.8	*87.5*	*51.6*	8.9	7.6	9.0	69	52	3.5	3.4	3.6	3.7	*97.2*	*91.9*	4.4	2.5	*56.8*	4.9	6.0	*81.7*	3.0
326192	12.6	*86.5*	*52.4*	9.9	8.6	9.9	70	47	3.25	3.15	3.8	3.7	*85.5*	*85.1*	4.7	2.75	58.5	5.3	6.3	*84.1*	3.3
308716	12.6	*91.3*	*57.9*	9.5	8.2	9.2	65	51	3.55	3.5	3.8	3.6	*93.4*	*97.2*	5.0	2.6	*52.0*	5.4	6.4	*84.4*	3.4
308674	13.4	*85.1*	*50.0*	8.4	7.2	9.0	72	48	3.5	3.65	3.8	3.65	*92.1*	*100.0*	4.95	2.6	*52.5*	5.1	[2] 5.9	*86.4*	3.4
314302	(10.6)	(*103.8*)	(*62.3*)	9.3	7.9	8.8	65	47	3.3	3.35	3.6	3.6	*91.7*	*93.1*	4.45	2.6	*58.4*				3.0
314320	12.5								3.4		3.5		*97.1*								
308708	13.4		*50.0*	9.0	8.0	9.3	71	51	3.55	3.6	3.8	3.8	*93.4*	*94.7*	5.1	2.5	*49.0*	4.8	6.4	*75.0*	
308621	[2] 12.3	*90.2*	*53.7*	9.2	8.2	9.4	71	55	3.4	3.4	3.65	3.55	*93.2*	*95.8*	4.7	2.35	*50.0*	5.2	6.1	*85.2*	3.1
308718					8.2	9.2			3.45		3.8		*90.8*		4.5	2.55	*56.7*				3.0
308734	12.4	*92.7*	*55.6*	8.9	7.4	8.6	65	46	3.2	3.35	3.55	3.6	*90.1*	*93.1*	4.7	2.3	*48.9*	5.1	5.9	*86.4*	3.5
308743	12.7	*87.4*	*53.5*	9.0	7.6	8.9	67	50	3.7		3.7		*100.0*		4.45	2.3	*51.7*	5.2	6.1	*85.2*	3.2
308739	12.6	*96.8*	*59.5*	9.2	7.8	9.4	67	49	3.45	3.5	3.6	3.5	*95.8*	*100.0*	5.2	2.5	*48.1*	5.3	6.7	*79.1*	3.45
314310	[2] 12.6				7.9	9.1			3.1		[2] 3.7		*83.8*		4.45	[2] 2.5	*56.2*				
Number of skulls	(42)	(*35*)	(*39*)	(40)	(41)	(47)	(39)	(39)	(44)	(41)	(44)	(11)	(*44*)	(*41*)	(46)	(44)	(*44*)	(39)	(38)	(*38*)	(43)
Totals	533.4			375.7	335.5	444.3			159.3	141.3	162.55	148.95			220.55	111.1		205.1	234.9		143.05
Averages	*12.70*	*89.21*	*53.58*	*9.39*	*8.18*	*9.45*	*69*	*51*	*3.42*	*3.45*	*3.69*	*3.63*	*92.46*	*94.86*	*4.79*	*2.53*	*52.74*	*5.26*	*6.18*	*85.14*	*3.33*
Minima	10.6	*80.9*	*48.1*	8.3	7.2	8.6	65	41	3.1	3.0	3.3	3.2	*83.8*	*84.6*	4.35	2.3	*45.0*	4.6	5.3	*75.0*	2.8
Maxima	13.7	*103.8*	*62.3*	10.4	8.8	10.2	75	63	3.8	3.75	4.0	3.9	*101.4*	*101.4*	5.45	2.75	*62.1*	5.7	6.7	*94.3*	3.8

[2] Near.

PUEBLOS—Continued

UNDEFORMED ARIZONA CRANIA.—FEMALE

SALT RIVER AND MISCELLANEOUS

Catalogue No.	Collection	Location	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
239524	Hemenway Expedition.	Salt River	Adult		16.8	12.2	13.2	*72.6*	*91.0*	*108.2*	14.07	1,105			6.7
239251	do	do	do		17.6	13.2	13.3	*75.0*	*86.4*	*100.8*	14.70	1,300			6.7
239457	do	do	35		16.5	12.8	13.1	*77.5*	*89.4*	*102.3*	14.13	1,250	Slight		7.2
239560	do	do	Adult		16.9	13.7	13.4	*81.1*	*87.6*	*97.8*	14.67	1,200			6.9
177881	J. W. Fewkes	Four-Mile Canyon	30	Slight lateral	16.2	12.6	12.8	*77.8*	*88.9*	*101.6*	13.87	1,110			7.0
243907	C. A. H., McCauly.	Las Animas River	35		16.7	13.1		*78.4*					Moderate	11.2	7.1
157686	J. W. Fewkes	Chaves Pass	55	Slight	16.7	13.3	12.6	*79.6*	*84.0*	*94.7*	14.20		All lost		
157671	do	do	30		15.8	13.8	12.8	*87.3*	*86.5*	*92.8*	14.13	[2] 1,300			6.2
107619	B. A. E	Near Tally Hogan	30		17	13.6	12.9	*80.0*	*84.3*	*94.9*	14.50	1,220	Slight		7.3
157452	J. W. Fewkes	Chevlon	40		16.4	13.3		*81.1*				[2](1,200)			
156328	do	Awatobi	60		15.8	[2] 14.3		*90.5*							
Number of skulls					(11)	(11)	(8)	(11)	(8)	(8)	(8)	(7)		(1)	(8)
Totals					182.4	145.9	104.1				114.27	8,485		11.2	55.1
Averages					*16.58*	*13.26*	*13.01*	*79.99*	*87.22*	*98.95*	*14.28*	*1,212*		*11.20*	*6.89*
Minima					15.8	12.2	12.6	*72.6*	*84.0*	*92.8*	13.87	1,105			6.2
Maxima					17.6	14.3	13.4	*90.5*	*91.0*	*108.2*	14.70	1,300			7.3

Catalogue No.	Diam. Bizygomatic maxim. (c)	Facial Index, total $\left(\frac{a \times 100}{c}\right)$	Facial Index, upper $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, left	Orbits—Height, right	Orbits—Breadth, left	Orbital Index, right	Orbital Index, left	Nose, height	Nose, breadth maxim.	Nasal Index	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	Upper Alveolar Arch, Index	Lower Jaw, height at Symphysis
239524	12.4		*54.0*	9.6		9.8	71	°	3.35	3.35	3.4	3.75	*91.9*	4.85	2.5	*51.6*	5.5	6.4	*85.9*	
239251				9.3		9.8	74		3.15	3.75				4.55	2.6	*57.1*				
239457	12.6		*57.1*	9.0	7.9	9.6	71	55	3.4	3.8	3.5	3.8	*92.1*	5.0	2.2	*44.0*	4.8	6.2	*77.4*	
239560	13.3		*51.9*	10.2		10.0	69		3.5	3.8	3.45	3.8	*90.8*	4.75	2.5	*52.6*	5.6	6.6	*84.9*	
177881	11.9		*58.8*			9.8			3.65	3.7		98.7								
243007	12.6	88.9	*66.4*		8.0				3.55	3.4	3.5	*104.4*	*101.4*	4.95	2.7	*54.6*	5.3	6.2	*85.5*	3.6
157685	12.8					9.6			3.45	3.6	3.7	*95.8*	*96.0*	5.0	2.35	*47.0*				
157671						8.5			3.1	3.65	3.5	*87.9*	*88.6*	4.5	2.35	*52.2*				
107619	13.1		*55.7*	9.8	8.5	9.8	68	49	3.5	3.7	3.7	*94.6*	*94.6*	5.25	2.6	*49.5*	5.4	6.5	*83.1*	
157452																				
156328																				
Number of skulls	(7)	(1)	(6)	(5)	(3)	(8)	(5)	(2)	(9)	(9)	(7)	(9)	(7)	(8)	(8)	(8)	(5)	(5)	(5)	(1)
Totals	88.7			47.9	24.4	76.9			30.65	33.15	25.7			38.85	19.80		26.6	31.9		3.6
Averages	*12.67*	*88.89*	*55.60*	*9.58*	*8.13*	*9.61*	*71*	*52*	*3.41*	*3.68*	*3.67*	*92.46*	*93.58*	*4.86*	*2.48*	*50.97*	*5.32*	*6.38*	*83.30*	*3.6*
Minima	11.9		*51.9*	9.0	7.9	8.5	68	49	3.1	3.4	3.5	*84.0*	*83.6*	4.5	2.2	*44.0*	4.8	6.2	*77.4*	
Maxima	13.3		*58.8*	10.2	8.5	10.0	74	55	3.65	3.8	3.8	*104.4*	*101.4*	5.25	2.7	*57.1*	5.6	6.6	*85.9*	

[1] Near.

PUEBLOS—Continued

DEFORMED NEW MEXICO CRANIA.—MALE

PUYE

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
263037	S. A. A., E. L. Hewett.	Puye	Adult.	Moderate asymmetry.	(16.4)	(14.0)	13.2	(85.4)	(86.8)	(94.3)	(14.53)	1,295		12.0	7.2
269289	B. A. E. and S. A. A.	do	do	Moderate occipital	(16.6)	(14.3)	(14.2)	(86.1)	(91.9)	(99.3)	(15.03)	(1,395)	Considerable.	11.7	7.1
263061	S. A. A., E. L. Hewett.	do	do	Moderate occipital compression.	(17.4)	(15.0)	13.9	(86.2)	(85.8)	(99.7)	(15.43)	(1,500)			
262982	do	do	do	do	(15.6)	(13.6)	12.4	(87.2)	(84.9)	(91.2)	(13.87)	1,100			6.4
262946	do	do	do	Moderate lateral compression.	(16.6)	(14.6)	13.4	(88.0)	(85.9)	(91.8)	(14.87)	1,365		11.4	6.7
269258	do	do	do	Marked occipital compression.	(16.2)	(14.4)	(13.4)	(88.9)	(87.6)	(93.1)	(14.67)	1,310		12.1	6.9
262971	do	do	do	Moderate occipital compression.	(16.1)	(14.4)	13.0	(89.4)	(85.3)	(90.5)	(14.50)	1,325		12.2	7.4
262923	do	do	do	Medium lateral compression.	(15.4)	(14.0)	(13.6)	(90.9)	(92.5)	(97.1)	(14.33)	1,265		11.1	6.7
269291	B. A. E. and S. A. A.	do	do	Moderate occipital compression.	(15.8)	(14.4)	13.6	(91.1)	(90.1)	(94.4)	(14.60)	1,320	Slight	12.6	7.6
263029	S. A. A., E. L. Hewett.	do	do	Marked occipital compression.	(16.2)	(14.8)	(14.2)	(91.4)	(91.6)	(96.0)	(15.07)	1,385			7.4
269275	B. A. E.	do	30	Considerable	(16.0)	(15.1)	(14.0)	(94.4)	(90.0)	(92.7)	(15.03)	[2] 1,450	Very slight.	12.1	7.7
263004	S. A. A., E. L. Hewett.	do	Adult.	Moderate occipital compression.	(16.5)	(15.6)	13.8	(94.6)	(86.0)	(88.5)	(15.30)	1,475			
262984	do	do	do	Marked occipital compression.	(16.6)	(15.7)	(14.2)	(94.6)	(87.9)	(90.5)	(15.50)	1,390			7.9
269255	do	do	do	do	(16.1)	(15.6)	(14.8)	(96.9)	(93.4)	(94.9)	(15.50)	1,570	Medium	11.1	7.0
269276	B. A. E.	do	40	Considerable	(14.6)	(15.4)	(13.8)	(105.5)	(92.0)	(89.6)	(14.60)	1,265	Moderate	11.4	7.2
269272	do	do	45	do									do	12.0	7.5
262948	S. A. A., E. L. Hewett.	do	Adult.	Marked lateral compression.	(15.9)		(14.2)					(1,305)	Medium	12.0	7.3

Number of skulls						(7)					(15)	(13)			(12)	(15)
Totals						93.3					222.83	17,515			141.7	108.0
Averages						*13.33*					*14.86*	*1,847*			*11.81*	*7.20*
Minima						12.4					13.87	1,100			11.1	6.4
Maxima						13.9					15.50	1,570			12.6	7.9

OTHER TEWA AND MISCELLANEOUS

271901	B. A. E. and S. A. A	Kwasteyukwa (Jemez)	65	Moderate	(17.7)	(14.7)	(13.8)	(85.1)	(85.2)	(93.5)	15.40	1,545			
271861	do	do	45	Medium lateral	(17.0)	(14.2)	(13.6)	(83.5)	(87.2)	(95.8)	14.93	1,380	Medium	12.4	7.6
271803	do	do	50	do	(16.3)	(14.0)	(13.8)	(85.9)	(91.1)	(98.6)	14.70	1,320	Moderate	11.4	7.3
271805	do	do	35	Pronounced	(17.4)	(15.0)	(13.4)	(86.2)	(82.7)	(89.3)	15.27	1,490	No wear	11.9	7.2
271905	do	do	60	Medium	(15.6)	(13.9)	(14.0)	(89.1)	(94.9)	(100.7)	14.59	1,165			7.2
271808	do	do	40	do	(16.7)	(15.0)	(13.8)	(89.8)	(87.1)	(92.6)	15.17	1,385	Moderate	11.3	6.9
271817	do	do	Adult	Marked	(16.4)	(15.3)		(93.3)				(1,330)			
271876	do	do	30	Medium	(15.9)	(15.4)	(14.6)	(96.9)	(93.5)	(94.8)	15.30	1,370	No wear	13.0	[2] 7.6
269225	do	Giusiwa	Adult	Moderate	(16.7)	(14.7)	(14.3)	(88.-)	(91.1)	(97.3)	15.23	1,395	Slight	12.5	7.6
228228	E. L. Hewett	Tshirege	35	Pronounced	(16.6)	(15.2)	(13.6)	(91.6)	(85.5)	(89.5)	15.13			12.1	7.2
228238	do	do	50	do											
228956	do	Otowi	35	do	(15.5)	(14.6)	(14.6)	(94.2)	(97.0)	(100.9)	14.90	1,350	Very slight	12.3	7.4
228924	do	do	35	do	(16.1)	(15.2)		(94.4)					Slight	12.2	7.5
228922	do	do	Adult	Moderate									do	11.8	7.2
229010	do	Tsankawi	do	Moderate lateral	(16.6)	(13.6)	13.7	(85.0)	(92.6)	(100.7)	14.43				7.2
229009	do	do	do	Moderate	(15.8)	(15.0)	(14.3)	(94.9)	(92.9)	(95.3)	15.03	[2] 1,370	All lost	(10.6)	6.9
228970	do	do	40	Medium											6.9
229011	do	Vigil Grt. Pajarito Park	Adult	Moderate	(16.3)	(14.4)	(14.2)	(88.3)	(92.5)	(98.6)	14.97	1,350	Moderate	11.5	7.1
327084	N. M. Judd, N. G. S.	Pueblo Bonito	do	Medium	(17.8)	(14.3)	(13.7)	(80.3)	(85.4)	(95.8)	15.27	(1,325)		12.1	7.0
327058	do	do	do	Moderate	(17.5)	(14.8)	(13.8)	(84.6)	(85.5)	(93.2)	15.37	1,355	Slight	11.8	6.9
327081	do	do	do	Medium	(17.4)	(14.8)		(85.1)				(1,515)		12.9	7.7
327088	do	do	do	Moderate	(16.7)	(15.3)		(91.6)				(1,355)		12.4	7.5
327052	do	do	do	Medium	(16.1)	(14.8)	(13.9)	(91.9)	(90.0)	(93.9)	14.93	1,150			(6.5)
327112	do	do	do	Marked	(16.8)	(15.8)	(13.4)	(94.1)	(82.2)	(84.8)	15.33	1,565			7.0
327100	do	do	do	do	(17.1)	(16.2)		(94.7)						12.7	7.5
327065	do	do	do	do	(15.7)	(15.8)	(14.4)	(100.6)	(91.4)	(91.1)	15.30	1,210	Very slight	11.8	6.9
340045	do	Chaco Canyon	do	Moderate	(17.6)	(15.6)	(14.0)	(88.6)	(84.8)	(89.7)	15.73	1,545	Medium	13.0	7.7
331211	do	do	do	do	(15.7)	(14.2)	(13.7)	(90.5)	(91.6)	(96.5)	14.53	1,210	do	12.1	7.3
315952	do	do	60	Medium	(17.6)		(14.6)						do	11.8	7.7
98721	W. H. Nelson	Upper San Francisco River.	25	do	(16.0)	(14.3)		(89.4)							7.1
327419	do	do	Adult	Pronounced											6.5

[2] Near.

PUEBLOS—Continued

DEFORMED NEW MEXICO CRANIA.—MALE—Continued

OTHER TEWA AND MISCELLANEOUS—Continued

Catalogue No.	Collection	Location	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlicka's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
340054	N.M.Judd,N.G.S.	Pescado	Adult	Slight	(16.8)	(15.1)	(15.0)	*(89.9)*	*(94.1)*	*(99.3)*	15.63	1,580	Medium	13.2	8.0
219170	Rev. M. Dumont	Isinate	45	Moderate	(16.2)	(14.7)	(14.2)	*(90.7)*	*(91.9)*	*(96.6)*	15.03	1,450	Moderate		7.4
317194	N. M. Judd	Manuelito	70	do	(16.6)	(14.4)	(14.4)	(86.8)	*(92.9)*	*(100.0)*	15.13	1,375	All lost		
317197	do	do	30	Medium	(14.8)	(13.9)	(13.7)	*(93.9)*	*(95.5)*	*(98.6)*	14.13	[2] 1,110	No wear	11.6	7.0
317196	do	do	35	Pronounced	(16.4)	(15.8)	(14.6)	*(96.5)*	*(90.7)*	*(92.4)*	15.60	1,615	Very slight	11.3	6.7
334437	E. B. Gerard	Mt. Roblero Hill	45	Moderate	(17.6)	(14.7)	(14.4)	*(83.5)*	*(89.2)*	*(98.0)*	15.57				
242533	A. M. M	New Mexico [3]	30	Pronounced	(15.5)	(14.8)	(14.6)	*(95.5)*	*(96.4)*	*(98.7)*	14.97	1,275			
332140	Mrs. Henry Graham.	Carton Co	25	Moderate	(16.0)	(15.4)		*(96.3)*				(1,440)	No wear	11.7	7.2
255326	H. H. Hotchkiss	Gila Natural Forest	Adult	do		(14.5)									7.1
Number of skulls											(27)	(23)		(24)	(33)
Totals											407.48	31,470		290.8	239.
Averages											*15.09*	*1,368*		*12.12*	*7.24*
Minima											14.13	1,110		11.3	6.5
Maxima											15.73	1,615		13.2	8.0

308645	F. W. Hodge	Havikuh	Adult	Moderate lateral compression.	(17.8)	(14.0)	(14.4)	(78.7)	(90.6)	(102.9)	(15.40)	1,485	Considerable	11.8	7.3
314289	do	do	do	Medium lateral compression.	(17.5)	(14.0)		(80.0)				(1,510)			
308726	do	do	do	Moderate asymmetry	(16.2)	(13.4)	(13.6)	(82.7)	(91.9)	(101.5)	(14.40)	(1,290)			6.5
308724	do	do	do	Moderate lateral compression.	(16.0)	(13.5)	(13.9)	(84.4)	(94.2)	(103.0)	(14.47)	1,265			
308717	do	do	do	Moderate asymmetry	(16.3)	(14.1)	13.4	(86.5)	(88.2)	(95.0)	(14.60)	1,285		11.9	7.3
314307	do	do	do	Moderate lateral compression.	(16.6)	(14.5)		(87.4)				[2] 1,380			6.8
314293	do	do	do	Moderate occipital compression.	(16.4)	(14.7)	13.6	(89.6)	(87.5)	(92.5)	(14.90)	1,330		13.2	7.9
332498	do	do	do	Marked occipital compression.	(16.2)	(14.7)	(13.8)	(90.7)	(89.3)	(93.9)	(14.90)	1,315		11.4	6.9
308614	do	do	do	Moderate occipital compression.	(16.4)	(15.0)	(13.4)	(91.5)	(85.4)	(89.3)	(14.93)	1,480		11.8	7.0
314279	do	do	do	do	(15.8)	(14.5)	13.3	(91.8)	(87.8)	(91.7)	(14.53)	1,290		12.6	7.4
314322	do	do	do	Moderate occipital deformation.	(15.7)	(14.6)	13.0	(93.0)	(85.8)	(89.0)	(14.43)	1,190	Medium	11.4	
314319	do	do	do	Moderate occipital compression.	(16.4)	(15.7)		(95.7)					Slight	(11.7)	7.4
308613	do	do	do	do	(15.3)	(15.1)	(13.4)	(98.7)	(88.2)	(88.7)	(14.60)	1,290		11.3	6.6
308606	do	do	do	do		(14.2)	(12.4)			(87.3)				12.3	7.3
308640	do	do	do	do	(16.2)								Considerable	12.3	7.9
Number of skulls							(4)				(10)	(10)		(10)	(12)
Totals							53.3				147.16	13,310		120.0	86.3
Averages							*13.33*				*14.72*	*1,331*		*12.00*	*7.19*
Minima							13.0				14.40	1,190		11.3	6.5
Maxima							13.6				15.40	1,485		13.2	7.9

[2] Near.

[3] Exact locality not known.

PUEBLOS—Continued

DEFORMED NEW MEXICO CRANIA.—MALE—Continued

PUYE

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
263037	13.3	*90.2*	*54.1*	9.7	8.7	9.6	° 68	° 59	3.2	3.3		3.6		*91.7*	4.9	2.4	*49.0*	5.4	6.6	*81.8*	3.6
269289	13.6	*86.0*	*52.3*	10.0	8.8	10.0	69	51	3.4	3.5	4.1	3.8	*82.9*	*92.1*	5.1	2.7	*52.9*	5.2	6.4	*81.3*	3.7
263061				9.9	8.9	10.3				3.4		4.1		*82.9*	5.2	2.4	*46.2*				
262982	12.9		*49.6*	9.7	8.6	9.4	69	54	3.3	3.45	3.6	3.6	*91.7*	*95.8*	4.4	2.4	*54.6*				
262946	13.9	*82.0*	*48.2*	(9.6)	(8.8)	(10.0)	(73)	(60)	3.4	3.4	3.75	3.8	*90.7*	*89.5*	4.8	2.4	*50.0*				3.2
269258	13.6	*89.0*	*50.7*	9.1	8.4	9.8	74	65	3.2	3.4	3.8	3.8	*84.2*	*89.5*	4.7	2.2	*46.8*	5.0	6.6	*75.8*	3.2
262971	12.9	*94.6*	*57.4*	9.5	8.5	9.5	67	56	3.35	3.5	3.5	3.55	*95.7*	*98.6*	5.3	2.4	*45.3*	5.2	6.5	*80.0*	3.5
262923	13.6	*81.6*	*49.3*	9.5	8.5	9.4	69	58	3.5	3.4	3.8	3.6	*92.1*	*94.4*	4.6	2.4	*52.2*				3.0
269291	13.3	*94.7*	*57.1*	8.8	7.8	9.6	71	59	3.4	3.5	3.65	3.6	*93.2*	*97.2*	5.2	2.45	*47.1*	5.3	6.1	*86.9*	3.8
263020	(13.8)		*(53.6)*	(9.3)	(8.5)	9.8	(71)	(65)	3.45	3.5	3.8	3.85	*90.8*	*90.9*	4.8	2.2	*45.8*				
269275	(13.9)	*(87.1)*	*(55.4)*	10.5	8.8	9.9	64	47	3.6	3.65	4.0	3.9	*90.0*	*93.6*	5.15	2.4	*46.6*	5.6	6.1	*91.8*	3.4
263004	13.5			10.1	8.7	10.2			3.6	3.7	4.0	3.9	*90.0*	*94.9*	4.9	2.5	*51.0*				
262984	(15.1)		*(52.3)*	(9.7)	(9.0)	(10.0)	(69)	(66)	3.6	3.65	4.1	4.2	*87.8*	*86.9*	5.5	2.7	*49.1*	5.5	6.7	*82.1*	
269255	(13.9)	*(79.9)*	*(50.4)*	(9.2)	(8.2)	9.8	(73)	(58)	3.6	3.6	3.9	3.85	*92.3*	*93.5*	4.7	2.3	*48.9*	5.4	5.7	*94.7*	3.4
269276	(13.9)	*(82.0)*	*(51.8)*	9.1	8.2	9.4	69	59	3.25	3.2	3.6	3.5	*90.3*	*91.4*	5.05	2.5	*49.5*	5.2	6.1	*85.3*	3.2
269272															5.1	2.2	*43.1*	5.5	6.7	*82.1*	3.65
262948				(9.2)	(8.2)	(10.3)	(76)	(58)	3.5		4.0		*87.5*		5.1	2.5	*49.0*	5.4	6.4	*84.4*	3.8
Number of skulls	(9)	(7)	(8)	(11)	(11)	(13)	(9)	(9)	(15)	(15)	(14)	(15)	*(14)*	*(15)*	(17)	(17)	*(17)*	(11)	(11)	*(11)*	(12)
Totals	120.6			105.9	93.9	126.7			51.35	52.15	53.6	56.65			84.5	41.05		58.7	69.9		41.45
Averages	*13.40*	*88.22*	*52.29*	*9.63*	*8.54*	*9.75*	*69*	*56*	*3.42*	*3.48*	*3.83*	*3.78*	*89.83*	*92.06*	*4.97*	*2.41*	*48.58*	*5.34*	*6.85*	*83.98*	*3.45*
Minima	12.9	*81.6*	*48.2*	8.8	7.8	9.4	64	47	3.2	3.2	3.5	3.5	*82.9*	*82.9*	4.4	2.2	*43.1*	5.0	5.7	*75.8*	3.0
Maxima	13.9	*94.7*	*57.4*	10.5	8.9	10.3	74	65	3.6	3.7	4.1	4.2	*95.7*	*98.6*	5.5	2.7	*54.6*	5.6	6.7	*94.7*	3.8

271901	13.7				9.1	10.2			3.55	3.5	3.9	3.8	*91.0*	*92.1*	4.9	2.65	*54.1*				
271861	13.6	*91.2*	*55.9*	9.9	8.5	9.8	67	52	3.6	3.55	3.9	3.95	*92.3*	*89.9*	5.1	2.65	*52.0*	5.7	6.4	*89.1*	3.7
271803	13.5	*84.4*	*54.1*	9.8	8.3	9.6	67	47	3.5	3.55	3.65	3.65	*95.9*	*97.3*	5.1	2.3	*45.1*	5.6	6.5	*86.2*	3.6
271805						9.7									5.1	2.85	*55.9*	5.7	6.7	*85.1*	3.4
271905	13.3		*54.1*	10.6	8.8	10.0	66	42	3.15	3.2	3.8	3.8	*82.9*	*84.2*	4.9	2.5	*51.0*	5.7	[2] 6.5	*87.7*	
271808	(14.3)	*(79.0)*	*(48.3)*	9.3	8.4	9.4	69	60	3.3	3.25	3.7	3.6	*89.2*	*90.3*	4.8	2.45	*51.0*	5.0	6.7	*74.6*	3.3
271817	13.4								3.35	3.55	4.0	3.9	*83.8*	*91.0*	4.8						
271876						9.9															3.85
269225	13.6	*91.9*	*55.9*	10.6	9.0	10.0	65	48	3.5	3.7	4.0	3.9	*87.5*	*94.9*	5.1	2.7	*52.9*	5.5	6.6	*83.3*	3.8
228228	(15.0)	*(80.7)*	*(48.0)*	10.4	9.0	10.1	67	49		3.6		3.9		*92.3*	5.0	2.75	*55.0*	5.5	6.9	*79.7*	3.8
228238										3.55		3.9		*91.0*	5.0	3.0	*60.0*				
228956	13.4	*91.8*	*55.2*	9.8	8.6	10.1	70	56	3.3		3.65		*90.4*		4.95	2.25	*50.5*	5.3	6.6	*80.3*	3.7
228924	(14.2)	*(85.9)*	*(52.8)*						3.2	3.4	4.1	3.9	*78.1*	*87.2*	5.0	2.6	*52.0*	6.1	7.0	*87.1*	3.7
228922	13.5	*87.4*	*53.3*	9.7	8.3	9.5	67	50	3.15		3.8		*82.9*		4.9	2.5	*51.0*	5.8	6.4	*90.6*	3.5
229010	13.7		*52.6*	9.9	8.5	10.0	70	48	3.45	3.4		3.7		*91.9*	5.1	2.9	*56.9*		6.7		
229009	13.1	*(80.9)*	*52.7*	10.7	9.1	10.3	68	42	3.75	3.8	4.0	3.9	*93.8*	*97.4*	4.9	2.7	*55.1*	5.9	5.9	*100.0*	3.5
228970									3.5	3.4	3.7	3.7	*94.6*	*91.9*	4.95	2.7	*54.6*	5.6	6.4	*87.5*	
229011	13.6	*(84.6)*	*(52.2)*	10.4	9.1	10.3	69	50		3.8		3.7		*102.7*	5.0	2.6	*52.0*	5.4	6.1	*88.5*	3.4
327084				9.3	8.4	10.0	74	60	3.5		3.8		*92.1*		4.8	2.4	*50.0*	5.0	6.4	*78.1*	3.3
327058	13.1	*90.1*	*52.7*	9.6	8.5	10.2	75	56	3.5	3.6	3.7	3.7	*94.6*	*97.3*	4.8	2.4	*50.0*	5.2	6.4	*81.3*	3.5
327081	12.4	*96.3*	*57.5*												5.3	2.5	*47.2*	5.3	6.3	*84.1*	3.6
327088										3.5		3.8		*92.1*	5.9	2.5	*42.4*	5.2	6.5	*80.0*	3.3
327052	12.8		*(50.8)*	9.0	8.0	9.7	76	54	3.3	3.2	3.6	3.45	*91.7*	*92.8*	4.8	2.4	*50.0*				
327112	13.9		*50.4*	(9.3)	(8.4)	(9.8)	(73)	(58)							5.2	2.2	*42.3*	5.2	6.3	*82.5*	
327100										3.2	4.0				5.3	2.6	*49.1*				3.8
327065	13.0	*90.8*	*53.1*	(9.5)	(8.5)	(10.1)	(75)	(59)	3.5	3.6	3.7	3.7	*94.6*	*97.3*	4.8	2.4	*50.0*	5.1	6.6	*77.3*	3.7
340045	14.0	*92.9*	*55.0*	10.2	8.7	10.0	67	48	3.6	3.7	3.95	3.8	*91.2*	*97.4*	5.4	3.0	*55.6*	5.6	6.4	*87.5*	3.8
331211				8.9	8.0	9.7	73	59	3.4	3.25	3.8	3.9	*89.5*	*83.3*	5.2	2.5	*48.1*				3.6
315952	14.2	*83.1*	*54.2*	9.4	8.4	10.4	74	59	3.7	3.8	4.2	4.2	*88.1*	*90.5*	5.35	2.75	*51.4*				[2] 3.6
98724	(14.1)		*(50.4)*						3.6	3.6	4.0	4.0	*90.0*	*90.0*	4.9	2.55	*52.0*	5.4	6.4	*84.4*	3.5
327419									3.4	3.4	3.65	3.5	*93.2*	*97.1*	4.5	2.6	*57.8*	5.4	6.5	*83.1*	
340054	14.5	*91.0*	*55.2*	9.7	8.4	10.4	71	56	3.9	3.8	4.0	3.95	*97.5*	*96.2*	5.2	2.3	*44.2*	5.6	6.6	*84.9*	3.7
219170	14.1		*52.5*		8.0	9.4			3.4	3.5	4.1	4.0	82.9	87.5	5.05	2.9	*57.4*				
317194	13.0				8.4	9.8			3.1	3.2	3.6	3.5	*86.1*	*91.4*	4.8	2.4	*50.0*				
317197	13.0	*89.2*	*53.9*	8.8	7.8	9.2	70	57	3.45	3.45	3.7	3.6	*93.2*	*95.8*	4.9	2.35	*48.0*	4.9	6.2	*79.0*	3.3
317196	(14.2)	*(79.6)*	*(47.2)*	10.3	8.9	10.2	71	48	3.3	3.3	3.8	3.8	*86.8*	*86.8*	4.7	2.45	*52.1*	5.9	6.4	*92.2*	3.6

[2] Near

PUEBLOS—Continued

DEFORMED NEW MEXICO CRANIA.—MALE—Continued

OTHER TEWA AND MISCELLANEOUS—Continued

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length, maxim.	Upper Alveolar Arch, breadth maxim	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
334437						10.4	°	°													
242533						10.6															
332140	13.3	*88.0*	*54.1*						3.45	3.45	3.9	3.8	*88.5*	*90.8*	4.9	2.55	*52.0*	5.6	6.3	*88.9*	3.55
255326	13.5		*52.6*						3.1	3.3	3.9	3.9	*79.5*	*84.6*	5.0	2.6	*52.0*		7.0		
Number of skulls	(24)	(14)	(20)	(20)	(23)	(27)	(20)	(20)	(29)	(31)	(29)	(30)	(28)	(30)	(37)	(36)	(56)	(26)	(28)	(26)	(26)
Totals	324.2			196.3	196.2	268.9			99.5	108.1	111.6	113.9			185.4	92.45		142.2	181.7		93.1
Averages	*13.5*	*89.46*	*53.85*	*9.82*	*8.53*	*9.96*	*70*	*52*	*3.48*	*3.49*	*3.85*	*3.80*	*89.27*	*92.10*	*5.01*	*2.57*	*51.19*	*5.47*	*6.49*	*84.64*	*3.58*
Minima	12.8	*83.1*	*50.4*	8.8	7.8	9.2	65	42	3.1	3.2	3.6	3.45	*78.1*	*83.3*	4.5	2.2	*42.3*	4.9	5.9	*74.6*	3.3
Maxima	14.5	*96.3*	*57.5*	10.7	9.1	10.6	76	60	3.9	3.8	4.2	4.2	*97.5*	*102.7*	5.9	3.0	*60.0*	6.1	7.0	*100.0*	3.85
OLD ZUNI																					
308645	13.7	*86.1*	*53.3*	10.1	9.0	10.4	71	55	3.5	3.4	4.0	3.9	*87.5*	*87.2*	5.1	2.5	*49.0*	5.4	6.2	*87.1*	3.7
314289																					
308726	12.7		*51.2*			9.7			3.45	3.4		3.65		*93.2*	4.8	2.4	*50.0*				
308724						9.7															
308717	13.3	*89.5*	*54.9*	9.9	8.6	10.0	69	52	3.7	3.8	3.9	3.85	*94.9*	*98.7*	5.0	2.4	*48.0*				3.5
314307										3.6		3.85		*93.5*	5.1	2.7	*52.9*				
314293				9.1	8.2	9.7	69	60	3.3	3.5		3.65		*95.9*	5.6	2.4	*42.9*	5.3	6.5	*81.5*	4.1
332498	13.4	*85.1*	*51.5*	10.0	8.7	9.9	69	50	3.5	3.35	3.55	3.6	*98.6*	*93.1*	4.8	2.4	*50.0*	5.8	6.6	*87.9*	3.4
308614	13.4	*88.1*	*52.2*	9.6	8.8	9.9	71	59	3.6	3.6	3.9	3.8	*92.3*	*94.7*	5.2	2.7	*51.9*	5.1	6.7	*76.1*	3.2
314279	13.7	*92.0*	*54.0*	10.0	8.7	10.0	68	51	3.6	3.7	3.75	3.7	*96.0*	*100.0*	5.1	2.3	*45.1*	5.3	6.2	*85.5*	3.5
314322	13.7	*83.2*			8.2	9.5			3.35	3.3	4.0	3.9	*83.8*	*84.6*	4.8	2.8	*58.3*	(5.1)	6.6	(77.3)	3.4
314319																		5.6	6.6	*84.8*	3.4

308613	13.2	*85.6*	*50.0*	9.7	8.3	9.4	67	42	3.2	3.25	3.85	3.7	*83.1*	*87.8*	4.8	2.4	*50.0*	5.1	6.2	*82.2*	3.1
308606	12.9	*95.4*	*56.6*	9.5	8.3	9.0	63	54	3.5	3.4	3.7	3.7	*94.6*	*91.9*	5.0	2.5	*50.0*	5.3	6.6	*80.3*	3.35
308640									3.8		4.1		*92.7*		5.5	2.6	*47.3*				3.6
Number of skulls	(9)	(8)	(8)	(8)	(9)	(11)	(8)	(8)	(11)	(11)	(9)	(11)	(9)	(11)	(12)	(12)	(12)	(8)	(9)	(8)	(11)
Totals	120.0			77.9	76.8	107.2			38.5	38.3	34.75	41.3			60.8	30.1		42.9	58.2		38.25
Averages	*13.33*	*88.07*	*52.96*	*9.74*	*8.53*	*9.75*	*69*	*54*	*3.50*	*3.48*	*3.86*	*3.75*	*91.37*	*92.74*	*5.07*	*2.51*	*49.51*	*5.36*	*6.47*	*83.14*	*3.48*
Minima	12.7	*83.2*	*50.0*	9.1	8.2	9.0	63	42	3.2	3.25	3.55	3.6	*83.1*	*84.6*	4.8	2.3	*42.9*	5.1	6.2	*76.1*	3.1
Maxima	13.7	*95.4*	*56.6*	10.1	9.0	10.4	71	60	3.8	3.8	4.1	3.9	*98.6*	*100.0*	5.6	2.8	*58.3*	5.8	6.7	*87.9*	4.1

DEFORMED ARIZONA CRANIA.—MALE

SALT RIVER

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum.)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
255291	Hemenway	Salt River	30	Slight, but some post-humous.	(18.1)	(12.2)	(13.6)	(67.4)	(89.8)	(111.5)	14.63				7.3
239608	do	do	Adult.	Moderate	(18.2)	(13.6)	(15.0)	(74.7)	(94.3)	(110.3)	15.60				
239627	do	do	do	do	[2] (18.8)	(14.7)		(78.2)							
239693	do	do	do	do	[2] (17.8)	(14.2)	(14.6)	(79.8)	(91.3)	(102.8)	15.53				
239649	do	do	do	Pronounced	(16.6)	(13.5)	(13.4)	(81.3)	(89.0)	(99.8)	14.50				7.6
239715	do	do	do	do	(17.8)	(14.6)	(14.2)	(82.0)	(87.7)	(97.3)	15.53	(1,350)			7.7
239516	do	do	do	do	(17.0)	(14.0)		(82.4)							8.0
239205	do	do	do	do	(17.1)	(14.1)	(14.5)	(82.5)	(93.0)	(102.8)	15.23	1,370	Considerable.	12.2	7.35
239559	do	do	do	do	(17.0)	(14.1)		(82.9)				(1,300)			[2] 7.4
239626	do	do	do	Slight	(17.2)	(14.4)	(14.4)	(83.7)	(91.1)	(100.0)	15.33				
239507	do	do	do	Pronounced	(16.2)	(13.7)		(84.6)				[2] 1,260			7.75
239614	do	do	do	Moderate	(17.6)	(14.9)	(14.7)	(84.7)	(90.5)	(98.7)	15.73	1,515	Considerable.	12.2	7.4
239602	do	do	do	Pronounced	(16.9)	(14.4)	(14.9)	(85.2)	(95.2)	(103.5)	15.40	1,290			
239617	do	do	do	do	(16.3)	(13.9)	(15.5)	(85.3)	(102.7)	(111.5)	15.23				[2] 7.7
239613	do	do	do	do	(17.3)	(14.8)	(14.2)	(85.6)	(88.5)	(96.0)	15.43	(1,200)			[2] 7.1
239650	do	do	do	Moderate	(17.1)	(14.7)	(14.6)	(86.0)	(91.8)	(99.3)	15.46	1,385	Considerable.	11.9	7.0
239217	do	do	do	Pronounced	(15.8)	(13.6)	(14.8)	(86.1)	(100.7)	(108.8)	14.73	[2] 1,250			
239511	do	do	do	do	(17.4)	(15.1)	(14.6)	(86.8)	(89.9)	(96.7)	15.70	1,460			8.2
239601	do	do	do	do	(16.8)	(14.6)	(14.8)	(86.9)	(94.3)	(101.4)	15.40	1,485			

[2] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—MALE—Continued

SALT RIVER—Continued

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad naximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
239701	Hemenway	Salt River	Adult	Pronounced	(16.3)	(14.2)	(14.7)	(87.1)	(96.4)	(103.5)	15.07	1,365			7.4
239562	do	do	do	Moderate	(17.0)	(14.9)	(15.1)	(87.7)	(94.7)	(101.3)	15.66	1,510			
239716	do	do	do	Pronounced	(16.6)	(14.6)	(14.4)	(88.0)	(92.3)	(98.6)	15.20	(1,270)			
239592	do	do	do	do	(16.0)	(14.1)		(88.1)				1,440			[3] 7.4
239714	do	do	do	do	(16.3)	(14.4)		(88.3)							7.2
239497	do	do	do	do	(16.8)	(14.9)	(14.4)	(88.7)	(90.9)	(96.6)	15.37	1,455		12.4	7.7
239520	do	do	do	do	(17.2)	(15.4)	(15.0)	(89.5)	(92.0)	(97.4)	15.87	1,590			8.2
239541	do	do	do	do	(15.2)	(13.6)	(14.6)	(89.5)	(101.4)	(107.4)	14.47	1,300			7.5
239602	do	do	do	do	(16.7)	(15.0)		(89.8)					Considerable	12.6	7.7
239330	do	do	do	do	(16.0)	(14.4)	(13.4)	(90.0)	(88.2)	(93.1)	14.60	1,200			7.3
239718	do	do	do	do	(16.0)	(14.6)	(14.4)	(91.3)	(94.1)	(98.6)	15.00	[2] 1,300			7.25
239648	do	do	do	Moderate	(16.1)	(14.7)		(91.3)							
239207	do	do	do	Pronounced	(16.0)	(14.8)	(14.6)	(92.5)	(94.8)	(98.7)	15.13	1,410		12.0	7.35
239508	do	do	do	do	(16.4)	(15.2)	(13.4)	(92.7)	(84.8)	(88.2)	15.00	1,495			7.1
239595	do	do	do	do	(16.7)	(15.6)	(14.7)	(93.4)	(91.0)	(94.2)	15.67	1,520			8.0
239544	do	do	do	do	(16.5)	(15.5)	(14.9)	(93.9)	(93.1)	(96.1)	15.63	1,500	Considerable	11.2	
239306	do	do	do	do	(16.3)	(15.4)	(15.2)	(94.5)	(95.9)	(98.7)	15.63	1,500	do	12.0	7.65
239539	do	do	do	do	(16.4)	(15.6)	(14.0)	(95.1)	(87.5)	(89.7)	15.33	1,430			7.7
239259	do	do	do	do	(15.6)	(14.9)	(15.2)	(95.5)	(99.7)	(102.0)	15.23	1,360			7.7
239687	do	do	do	do	(15.9)	(15.2)	(13.8)	(95.6)	(88.8)	(90.8)	14.97	[2] 1,280			7.3
239576	do	do	do	do	(16.6)	(15.9)		(95.8)				1,480			
239632	do	do	do	do	(15.7)	(15.2)		(96.8)							
239298	do	do	do	do	(14.7)	(14.6)	(14.6)	(99.3)	(99.6)	(100.0)	14.63	[2] 1,175			
239532	do	do	do	do	(15.1)		(14.4)					[2] 1,390			7.5
239506	do	do	do	do											7.3
239570	do	do	do	do		(15.7)	(15.0)			(95.5)					7.5
239717	do	do	do	do	(16.8)		(13.8)					[2] 1,515		12.5	7.9
239547	do	do	do	do	(16.6)										7.9
239564	do	do	do	do			(14.1)								6.8
239487	do	do	do	do	(15.2)		(14.6)						Considerable	11.9	7.2
239566	do	do	do	do		(15.3)	(14.4)			(94.1)		[2] 1,330			

239625	do	do	do	do									Considerable	12.1	7.3
239467	do	do	do	do											7.1
239581	do	do	do	Moderate		(13.9)									7.5
239216	do	do	do	?											7.35
239554	do	do	do	?											
239607	do	do	do	?									Considerable	11.6	7.2
239679	do	do	do	?											7.5
Number of skulls											(32)	(29)		(12)	(41)
Totals											487.89	40,560		144.6	307.0
Averages											*15.25*	*1,399*		*12.05*	*7.49*
Minima											14.47	1,175		11.2	6.8
Maxima											15.87	1,590		12.6	8.2

OLD HOPI

156326	J. W. Fewkes	Awatobi	65	Medium lateral	(17.3)	(13.7)		(*79.2*)				[2] 1,400			7.5
156319	do	Sikyatki	40	Moderate lateral	(17.4)	(14.1)	(14.0)	(*81.0*)	(*88.9*)	(*99.3*)	15.17	1,370	Slight	11.7	7.2
156876	do	Homolobi	50	Slight	(16.4)	(14.0)	[2] (13.5)	(*85.4*)	(*88.8*)	(*96.4*)	14.63				7.3
156320	do	Sikyatki	40	Considerable	[2] (16.4)	(14.8)		(*90.2*)				1,380			8.1
156325	do	Awatobi	45	Medium											7.6
Number of skulls											(2)	(3)		(1)	(5)
Totals											29.8	4,150		11.7	37.7
Averages											*14.90*	*1,383*		*11.7*	*7.54*
Minima											14.63	1,370		11.7	7.2
Maxima											15.17	1,400		11.7	8.1

ELDEN

339725	J. W. Fewkes	Elden	35	Medium lateral	(17.5)	(14.2)	(15.4)	(*81.1*)	(*97.2*)	(*108.5*)	15.70	1,570	No wear	12.9	7.8
339723	do	do	45	do	(16.9)	(14.1)	(13.8)	(*82.4*)	(*89.0*)	(*97.9*)	14.93	1,340	Slight	12.6	7.4
339724	do	do	60	Pronounced	(16.0)	(14.1)	(14.3)	(*88.1*)	(*95.0*)	(*101.4*)	14.80	1,380			
339722	do	do	60	do	(17.3)	(15.4)	(14.6)	(*89.0*)	(*89.3*)	(*94.8*)	15.77	1,580	Medium	11.4	7.2
339721	do	do	65	do	(15.9)	(14.4)	(14.8)	(*90.6*)	(*97.7*)	(*102.8*)	15.03	1,360			
339718	do	do	40	do	(16.4)	(15.6)		(*95.1*)					Slight	12.4	7.5
339729	do	do	40										Very slight	12.3	7.6
Number of skulls											(5)	(5)		(5)	(5)
Totals											76.23	7,230		61.6	37.5
Averages											*15.25*	*1,446*		*12.32*	*7.50*
Minima											14.80	1,340		11.4	7.2
Maxima											15.77	1,580		12.9	7.8

[2] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—MALE—Continued

CHAVES PASS

Catalogue No.	Collection	Location	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Ilrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
156996	J. W. Fewkes	Chaves Pass	55	Moderate	(17.8)	(14.2)	(15.2)	(79.8)	(95.0)	(107.0)	15.73				
157670	do	do	60	do	(16.3)	(13.5)	(13.1)	(82.8)	(87.9)	(97.0)	14.30	1,300			
158172	do	do	60	Pronounced	(17.5)	(14.6)	(14.9)	(83.4)	(92.8)	(102.1)	15.67	1,510			7.7
157665	do	do	50	Moderate	(17.0)	(14.2)	(14.0)	(83.5)	(89.7)	(98.6)	15.07	1,390			8.0
157685	do	do	60	do	(16.0)	(13.6)		(85.0)					All lost		
157675	do	do	40	Medium	(15.8)	(13.6)	(13.8)	(86.1)	(93.9)	(101.5)	14.40	1,240			7.2
158043	do	do	40	Medium lateral	(16.6)	(14.4)	(13.6)	(86.8)	(87.7)	(94.4)	14.87	1,420			7.5
157668	do	do	35	Slight	(16.8)	(14.6)	(14.2)	(86.9)	(90.5)	(97.8)	15.20	1,395			7.5
158173	do	do	65	Pronounced	(17.2)	(15.0)	(15.2)	(87.2)	(94.4)	(101.8)	15.80	1,620			
158117	do	do	60	do	(16.6)	(14.6)	(14.7)	(88.0)	(94.2)	(100.7)	15.30	1,415			
158109	do	do	40	do	(16.2)	(14.8)	(14.6)	(91.4)	(94.2)	(98.7)	15.20	1,350			7.7
158109	do	do	60	do	(16.0)	(14.9)	(14.7)	(93.1)	(95.1)	(98.7)	15.20	1,535			
157674	do	do	55	do	(16.0)	(14.9)	(14.0)	(93.1)	(90.6)	(94.0)	14.97	1,335			7.2
157688	do	do	65	do	(16.1)	(15.2)	(13.4)	(94.4)	(85.6)	(88.2)	14.90	(1,470)			
157681	do	do	24	do	(15.8)	(15.0)	(13.8)	(94.9)	(89.6)	(92.0)	14.87	[2] 1,465	No wear		7.1
157662	do	do	65	do	(16.2)	(15.7)	(14.5)	(96.9)	(90.9)	(92.4)	15.47	1,525			7.6
158171	do	do	35	do											7.5
157683	do	do	25	do									No wear		6.8
Number of skulls											(15)	(13)			(11)
Totals											226.95	18,500			81.8
Averages											*15.13*	*1,423*			*7.44*
Minima											14.13	1,240			6.8
Maxima											15.80	1,620			8.0

213348	W. Hough	Petrified forest	30	Moderate (and some posthumous)	(17.8)	(13.2)	(15.0)	(74.2)	(56.8)	(113.6)	15.33	1,450	No wear	11.5	7.4
213316	do	do	35	Moderate	(18.6)	(14.2)	(14.8)	(78.9)	(91.9)	(104.2)	15.67	[2] 1,550	do	13.0	7.7
213343	do	do	55	Medium	(16.2)	(13.6)	(13.7)	(84.0)	(91.9)	(100.7)	14.50	1,180	Medium		7.0
213345	do	do	30	do	(15.8)	(13.8)	(13.7)	(87.3)	(92.6)	(99.3)	14.43	1,290	No wear	11.8	6.9
213342	do	do	65	Moderate	(16.1)	(14.1)	(14.6)	(87.6)	(92.7)	(99.3)	14.73	1,240	Medium	11.4	6.9
213308	do	do	30	Medium	(15.8)	(15.0)		(89.3)				(1,630)		12.5	7.8
213353	do	do	35	do	(16.9)	(15.2)	(13.1)	(89.9)	(81.6)	(86.2)	15.67	1,460	No wear	12.1	7.4
213350	do	do	45	Pronounced	(16.4)	(14.8)	[2](14.1)	(90.2)	(90.4)	(95.3)	15.10	1,430	Slight	12.0	7.3
213332	do	do	30	Considerable	(15.8)	(14.6)	(14.1)	(92.4)	(92.8)	(93.6)	14.83	1,380	No wear	12.1	7.3
213310	do	do	35	Pronounced	(16.0)	(15.0)		(93.8)				[2] 1,450	Very slight	12.9	7.9
213318	do	do	55	Considerable	(15.5)	(14.8)	(14.0)	(95.5)	(92.4)	(94.6)	14.77				
213340	do	do	50	do	(16.2)	(15.5)	(14.1)	(95.7)	(89.0)	(91.0)	15.27	1,385	Slight	12.5	7.6
213317	do	do	30	do	(15.9)	(15.6)	(14.7)	(98.1)	(93.3)	(94.2)	15.40	1,600			7.5
Number of skulls											(11)	(11)		(10)	(12)
Totals											169.1	15,415		121.8	88.7
Averages											*15.01*	*1,401*		*12.18*	*7.39*
Minima											14.43	1,180		11.4	6.9
Maxima											15.67	1,600		13.0	7.9

MISCELLANEOUS

213299	W. Hough	McDonalds Canyon	24	Medium	(16.6)	(13.2)	(14.2)	(82.5)	(97.5)	(107.6)	14.47	1,310			7.3
213305	do	do	50	do	(17.7)	(14.9)	(14.4)	(84.2)	(88.5)	(96.6)	15.67	1,420			7.1
213306	do	do	40	do	(16.6)	(14.2)		(85.5)				[2] 1,350			7.6
213285	do	do	30	Considerable	(16.9)	(14.4)	(14.4)	(90.6)	(94.7)	(100.6)	14.93	1,475			7.4
213304	do	do	60	Medium	(16.2)	(14.6)	[2](14.6)	(90.1)	(90.9)	(95.2)	14.93	1,445			7.7
213291	do	do	35	do	(16.6)	(14.8)	(13.6)	(92.5)	(88.5)	(91.9)	14.80	1,410			7.2
213293	do	do	55	Considerable	(15.8)	(14.7)	(13.9)	(93.0)	(91.2)	(94.6)	14.80	1,330			7.2
246970	do	Graham Co	50	do	(16.4)	(14.5)		(88.4)					Medium	12.1	7.7
246985	do	do	35	do	(15.8)	(15)	(13.9)	(94.9)	(90.5)	(93.7)	14.90		Slight	13.4	8.0
246988	do	do	55	do	(15.9)	(15.2)	(14.5)	(95.6)	(93.8)	(95.4)	15.20	1,500	Nearly all lost		7.2
246991	do	do	25	do		(15.4)	(13.3)			(86.4)			No wear	11.7	7.2
246995	do	do	25	do											7.7
246989	do	do	25	Slight	(16.4)		(13.6)						No wear	12.3	7.3
176949	J. W. Fewkes	Kintiel	55	Medium	(17.3)	(14.4)		(83.2)				[2] 1,390			7.8
176939	do	do	50	do	(16.2)	(14.8)	(13.4)	(91.4)	(86.5)	(90.5)	14.80	1,300	Medium	11.7	7.1
176941	do	do	55	do	(15.7)	(15.1)		(96.2)				[2] 1,370			7.1
176950	do	do	50	Considerable	(15.4)	(14.9)		(96.8)				[2] 1,320	Medium		7.2
177874	do	Four-mile Canyon	40	Medium lateral	(16.3)	(12.6)	(13.2)	(77.3)	(91.8)	(104.8)	14.03	1,140	Very slight		6.8
177873	do	do	50	Pronounced	(15.6)	(14.0)		(89.7)					Moderate		8.1

[2] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—MALE—Continued

MISCELLANEOUS—Continued

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. anteroposterior-maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
177875	J. W. Fewkes	Four-mile Canyon	35	Considerable	(15.8)	(15.2)	[2](15.0)	*(96.2)*	*(96.8)*	*(98.7)*	15.33		No wear		7.5
270460	do	Black Falls	35	Medium lateral	(17.1)	(14.4)	(13.1)	*(84.2)*	*(83.2)*	*(91.0)*	14.87	1,430	do	12.6	7.6
270465	do	do	35	Considerable	(15.8)	(13.4)	(13.8)	*(84.8)*	*(94.5)*	*(103.0)*	14.33	1,285	do	11.4	7.0
270463	do	do	25	do	(15.4)	(15.0)	(14.4)	*(97.4)*	*(94.7)*	*(96.0)*	14.93	1,485	do	12.7	[2]7.5
157385	do	Chevlon	25	Medium lateral	(17.8)	(14.0)	(14.0)	*(78.7)*	*(88.1)*	*(100.0)*	15.27	1,450		12.5	7.4
243903	G. M. Braxton	Camp Verde	60	do	(18.0)	(14.7)	(13.5)	*(81.7)*	*(82.6)*	*(91.8)*	15.40	1,420			
213356	W. Hough	Navajo Co	25	Moderate	(16.6)	(14.1)	(13.8)	*(84.9)*	*(89.9)*	*(97.9)*	14.83	1,450	No wear		7.2
336959	Mrs. Evelyn Perkins.	Rio Verde	50	Medium lateral	(16.6)	(14.4)	(13.8)	*(86.8)*	*(89.0)*	*(95.8)*	14.93	[2]1,290	Slight	12.3	7.4
229364	F. M. Palmer	Crescent Cliff	30	Medium	(16.6)	(14.9)	(13.5)	*(89.8)*	*(85.7)*	*(90.6)*	15.00	1,380	No wear	12.4	7.4
300010	E. F. Frisbee	Foot of Tonachi Mountain, Navaho Reservation.	55	Considerable	(16.8)	(15.4)	(14.0)	*(91.7)*	*(87.0)*	*(90.9)*	15.40	1,410	Medium		[2]7.7
213327	W. Hough	Snowflake	24	do	(16.0)	(14.8)	(14.6)	*(92.5)*	*(94.8)*	*(98.7)*	15.13	1,440	No wear	11.7	6.9
243823	W. H. Gardner	Fort Grant	50	Pronounced	(15.6)	(15.0)	(13.6)	*(96.2)*	*(88.9)*	*(90.7)*	14.73	1,310			7.0
257536	J. W. Fewkes	Casa Grande	40	Considerable			(13.1)						Slight	11.7	7.4
243821	R. Smith	Prescott	60	Moderate	(17.0)		(13.1)								
Number of skulls											(22)	(24)		(13)	(31)
Totals											328.68	33,110		158.5	229.0
Averages											*14.94*	*1,380*		*12.19*	*7.39*
Minima											14.03	1,140		11.4	6.8
Maxima											15.67	1,500		13.4	8.1

Catalogue No.	Diam. Bizygomatic maxim. (c)	Facial Index, total $\left(\frac{a \times 100}{c}\right)$	Facial Index, upper $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	Orbital Index, right	Orbital Index, left	Nose, height	Nose, breadth maxim.	Nasal Index	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	Upper Alveolar Arch, Index	Lower Jaw, height at Symphysis
							°	°													
255291	12.6	.....	57.9	9.9	8.3	9.7	67	42	...	.....	.....	.....	.....	.....	5.3	2.5	47.2	5.4	6.2	87.1	.....
239608	.....	.....	.....	2 (10.7)	.....	(11.2)	.....	.....	2 3.5	.....	3.8	.....	92.1	.....	5.0	2.7	54.0	.....	.....	.....	.....
239627	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.7	.....	2 4.2	.....	88.1	.....	.....	.....	.....	.....	.....	.....
239693	2 13.2	.....	.....	.....	.....	.....	.....	.....	3.75	3.75	3.85	3.8	97.4	98.7	.....	.....	.....	.....	.....	.....	.....
239649	12.5	.....	60.8	(9.9)	.....	(9.8)	(67)	.....	3.75	3.85	4.0	3.9	93.8	98.7	5.35	2.4	44.9	5.85	6.2	94.4	.....
239715	.....	.....	.....	(10.5)	.....	(10.9)	(72)	.....	3.3	3.45	.....	.....	.....	.....	5.35	.....	.....	2 5.6	6.5	86.2	.....
239516	.....	.....	.....	.....	.....	.....	.....	.....	3.5	3.5	3.75	3.75	93.4	93.4	5.4	2.5	46.3	.....	.....	.....	.....
239205	13.6	89.7	54.0	(9.8)	.....	(10.4)	(73)	.....	3.2	3.2	3.5	3.5	91.4	91.4	5.2	2.45	47.1	5.2	6.7	2 77.6	.....
239559	13.0	.....	56.9	.....	.....	.....	.....	.....	3.3	3.35	3.7	3.6	89.2	93.1	4.6	2.5	54.4	.....	.....	.....	.....
239626	2 13.5	.....	.....	2 9.5	.....	10.2	.....	.....	3.55	3.55	3.8	3.85	93.4	92.2	5.25	2.45	46.7	.....	.....	.....	.....
239507	12.8	.....	60.5	.....	.....	.....	.....	.....	3.5	.....	3.9	.....	89.7	.....	5.35	2.6	48.6	.....	.....	.....	.....
239614	14.8	82.4	50.0	(10.1)	.....	(11.0)	(76)	.....	3.5	3.6	4.1	4.1	85.4	87.8	5.45	2.8	51.4	5.4	7.0	77.1	.....
239602	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.1	.....	2 3.9	.....	105.1	5.35	2.4	44.9	2 5.3	6.1	86.9	.....
239617	.....	.....	.....	2 (9.5)	.....	(10.2)	(72)	.....	.....	3.45	.....	4.0	.....	86.3	5.0	2.7	54.0	5.3	6.5	81.5	.....
239613	.....	.....	.....	10.0	.....	10.4	73	.....	.....	.....	.....	.....	.....	.....	5.05	2.6	51.5	5.2	6.8	76.5	.....
239650	13.8	86.2	50.7	(9.8)	.....	(10.7)	(78)	.....	3.2	3.25	3.6	3.5	88.9	92.9	.....	.....	.....	.....	.....	.....	.....
239217	.....	.....	.....	.....	.....	(10.2)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
239511	14.3	.....	57.3	.....	.....	10.4	.....	.....	3.45	3.5	3.85	3.85	89.6	90.9	5.4	2.85	52.8	.....	.....	.....	.....
239601	14.4	.....	.....	.....	.....	10.8	.....	.....	3.7	3.6	4.0	3.9	92.5	92.3	5.1	2.7	52.9	.....	.....	.....	.....
239701	14.2	.....	52.1	(9.8)	.....	(10.2)	(72)	.....	3.7	3.6	3.95	3.95	93.7	91.2	5.2	2.7	51.9	5.55	6.65	83.5	.....
239562	13.5	.....	.....	2 (9.8)	.....	(10.2)	.....	.....	3.4	3.4	3.6	3.7	94.4	91.9	5.2	2.5	48.1	.....	.....	.....	.....
239716	13.1	.....	.....	9.4	.....	8.0	.....	.....	3.35	3.5	3.9	3.85	85.9	90.9	4.8	2.45	51.0	5.1	6.3	81.0	.....
239592	13.5	.....	54.8	.....	.....	.....	.....	.....	3.15	3.4	3.8	3.8	82.9	89.5	5.1	2.5	49.0	5.4	.....	.....	.....
239714	12.8	.....	56.3	.....	.....	.....	.....	.....	3.15	3.15	3.85	3.85	81.8	81.8	4.8	2.6	54.2	.....	.....	.....	.....
239497	13.7	90.5	56.2	(10.0)	.....	(10.2)	(70)	.....	3.2	3.35	3.75	3.7	85.4	90.5	5.25	2.5	47.6	5.6	2 6.6	84.9	.....
239520	14.3	.....	57.3	(10.1)	.....	(10.4)	(69)	.....	3.8	3.8	4.0	3.8	95.0	100.0	5.85	2.55	43.6	5.6	.....	.....	.....
239541	13.2	.....	56.8	(10.1)	.....	(10.4)	(71)	.....	3.75	3.7	3.8	3.8	98.7	97.4	5.35	2.65	49.5	5.1	2 6.5	78.5	.....
239692	14.2	88.7	54.2	(10.3)	.....	(10.6)	(71)	.....	3.6	3.7	4.05	4.0	88.9	92.5	5.45	2.7	49.5	5.7	6.3	90.5	.....
239330	13.8	.....	52.9	9.8	.....	9.8	69	.....	3.4	3.4	3.75	3.9	90.7	87.2	5.2	2.7	51.9	5.4	.....	.....	.....
239718	13 0	.....	55.8	(9.0)	.....	(9.6)	(72)	.....	3.55	3.7	3.6	3.6	98.6	102.8	5 6	2.45	48.8	5.0	6.0	83.3	.....
239648	14.0	.....	.....	.....	.....	.....	.....	.....	3.25	3.4	3.95	3.9	82.3	87.2	5.2	2.5	48.1	.....	.....	.....	.....
239207	2 13.4	89.6	54.9	(9.8)	.....	(9.7)	(68)	.....	3.65	3.7	3.9	3.9	93.6	94.9	5.0	2.8	56.0	5.45	6.6	82.6	.....
239508	13 8	.....	51.4	(9.3)	.....	(10.1)	(75)	.....	3.35	3.55	3.9	3.75	85.9	94.7	5.3	2.7	50.9	5.4	6.1	88.5	.....
239595	2 13.5	.....	59.3	10.4	.....	10.2	67	.....	3.5	3.55	3.95	3.8	88.6	93.4	5.5	2.6	47.3	5.7	7.0	81.4	.....

2 Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—MALE—Continued

SALT RIVER—Continued

Catalogue No.	Diam. Bizygomatic maxim. (c)	Facial Index, total $\left(\frac{a \times 100}{c}\right)$	Facial Index, upper $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	Orbital Index, right	Orbital Index, left	Nose, height	Nose, breadth maxim.	Nasal Index	Upper Alveolar Arch, length, maxim.	Upper Alveolar Arch, breadth maxim.	Upper Alveolar Arch, Index	Lower Jaw, height at Symphysis
							°	°													
239544	14.4	*77.8*	.....	[2] (9.6)	.....	(10.2)	.....	.....	3.5	3.55	3.8	3.9	*92.1*	*91.0*	5.55	2.65	*47.7*	[2] 5.1	[2] 6.7	*76.1*	.....
239306	14.0	*85.7*	*54.6*	10.1	.....	10.4	70	.....	3.3	3.25	3.8	3.75	*86.8*	*86.7*	5.3	2.45	*46.2*	5.15	6.5	*79.2*	.....
239539	13.7	.....	*56.2*	(9.4)	.....	(9.8)	(69)	.....	3.35	3.2	3.6	3.6	*93.1*	*88.9*	4.9	2.55	*52.0*	5.45	6.6	*82.6*	.....
239259	14.1	.....	*54.7*	(9.6)	.....	(10.1)	(71)	.....	3.35	3.5	3.85	3.75	*87.0*	*93.4*	5.35	2.3	*43.0*	5.2	6.7	*77.6*	.....
239687	13.9	.....	*52.5*	9.4	.....	10.2	74	.....	3.4	3.5	3.8	.....	*89.5*	.....	5.2	2.65	*51.0*	5.0	.....	.....	.....
239576	.....	.....	.....	.....	.....	(10.9)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
239632	.....	.....	.....	.....	.....	.....	.....	.....	4.1	4.1	[2] 4.15	4.2	*98.8*	*97.6*	[2] 5.9	[2] 2.7	*45.8*	[2] 5.5	7.1	[2] *77.5*	.....
239238	.....	.....	.....	.....	.....	9.6	.....	.....	3.3	3.3	3.8	3.7	*86.8*	*89.2*	5.0	2.4	*48.0*	.....	.....	.....	.....
239532	[2] 13.2	.....	*56.8*	(9.35)	.....	(9.8)	(70)	.....	3.35	3.45	3.6	3.6	*93.1*	*95.8*	5.6	2.6	*46.4*	5.25	6.6	*79.6*	.....
239506	[2] 12.3	.....	*59.4*	.....	.....	.....	.....	.....	3.65	3.75	4.15	4.1	*88.0*	*91.5*	5.15	2.55	*49.5*	5.3	6.0	*88.3*	.....
239570	.....	.....	.....	(9.4)	.....	(9.8)	(70)	.....	.....	.....	.....	.....	.....	.....	5.4	2.5	*46.3*	.....	.....	.....	.....
239717	13.0	*96.2*	*60.8*	10.1	.....	10.2	68	.....	3.65	3.7	3.8	3.7	*96.1*	*100.0*	5.35	2.4	*44.9*	5.7	6.4	*89.1*	.....
239547	.....	.....	.....	.....	.....	.....	.....	.....	3.7	3.7	3.9	4.0	*94.9*	*92.5*	5.35	2.3	*43.0*	.....	.....	.....	.....
239564	.....	.....	.....	(9.4)	.....	(10.0)	(74)	.....	3.4	3.35	3.95	3.8	*86.1*	*88.2*	4.9	2.4	*49.0*	4.85	6.3	*77.0*	.....
239487	13.2	*90.2*	*54.6*	10.1	.....	10.4	72	.....	3.35	3.3	3.6	3.6	*93.1*	*91.7*	5.0	2.4	*48.0*	5.45	.....	.....	.....
239566	13.4	.....	.....	.....	.....	(10.1)	.....	.....	3.3	3.4	3.8	3.9	*86.8*	*87.2*	4.8	2.55	*53.1*	.....	.....	.....	.....
239625	13.4	*90.3*	*54.5*	9.3	.....	9.8	72	.....	3.3	3.3	3.6	3.55	*91.7*	*93.0*	5.15	2.25	*43.7*	5.15	6.3	*81.8*	.....
239467	14.0	.....	*50.7*	.....	.....	.....	.....	.....	3.3	3.35	3.7	3.7	*89.2*	*90.5*	5.1	2.6	*51.0*	5.25	6.6	*79.5*	.....
239581	.....	.....	.....	.....	.....	.....	.....	.....	3.6	3.65	3.75	3.75	*96.2*	*97.3*	5.2	2.2	*42.3*	5.1	6.8	*75.0*	.....
239216	.....	.....	.....	.....	.....	.....	.....	.....	3.55	3.6	3.7	3.65	*96.0*	*98.6*	5.55	2.45	*44.1*	5.45	6.5	*83.9*	.....
239551	.....	.....	.....	.....	.....	.....	.....	.....	3.6	3.65	3.9	3.9	*92.3*	*93.6*	5.65	2.7	*47.8*	.....	.....	.....	.....
239607	12.7	*91.3*	*59.7*	9.6	.....	10.2	73	.....	3.6	3.6	4.05	4.15	*88.9*	*86.8*	5.15	2.4	*46.6*	[2] 5.5	6.2	[2] *88.7*	.....
239679	.....	.....	.....	.....	.....	.....	.....	.....	3.35	3.45	3.7	3.8	*90.5*	*90.8*	5.5	2.55	*46.4*	5.0	7.0	*71.4*	.....
Number of skulls	(39)	(12)	(31)	(12)	(1)	(15)	(10)	(1)	(49)	(50)	(48)	(48)	(48)	(48)	(52)	(51)	(51)	(38)	(32)	(32)	.....
Totals	527.8	.....	.....	117.6	8.3	150.3	.....	.....	179.0	176.4	183.6	183.25	.....	.....	273.0	129.6	.....	202.95	208.35	.....	.....
Averages	*13.53*	*88.06*	*55.45*	*9.80*	*8.3*	*10.02*	*71*	*42*	*3.42*	*3.52*	*3.83*	*3.82*	*90.80*	*92.47*	*5.25*	*2.54*	*48.43*	*5.24*	*6.51*	*81.56*	.....
Minima	12.3	*77.8*	*50.0*	9.3	.....	8.0	67	.....	3.15	3.15	3.5	3.5	*81.8*	*81.8*	4.6	2.2	*42.3*	4.85	6.0	*71.4*	.....
Maxima	14.8	*96.2*	*60.8*	10.4	.....	10.8	74	.....	4.1	4.1	4.15	4.2	*98.8*	*105.1*	5.9	2.85	*56.0*	5.85	7.1	*94.4*	.....

OLD HOPI

156326	13.3		*56.4*						3.35	3.5	4.0	3.9	*83.5*	*89.7*	5.2	2.5	*48.1*	[2]5.7	[2]6.2	*91.9*	
156319	13.1	*89.3*	*55.0*	9.4	8.0	10.0	73	51	3.35	3.4	3.7	3.8	*90.5*	*89.5*	4.9	2.5	*51.0*	5.2	6.4	*81.3*	3.25
156876	13.3		*54.9*						3.45	3.4	3.75	3.85	*92.0*	*88.3*	4.9	2.3	*46.9*	5.3	6.7	*79.1*	
156320	13.9		*58.3*						3.8	3.7	4.0	4.0	*95.0*	*92.5*	5.55	2.75	*49.6*	6.3	6.9	*91.3*	
156325									3.55	3.55	4.0	4.0	*88.8*	*88.8*	5.3	2.8	*52.8*				
Number of skulls	(4)	(1)	(4)	(1)	(1)	(1)	(1)	(1)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(4)	(4)	(4)	(1)	
Totals	53.6			9.4	8.0	10.0			17.5	17.55	19.45	19.55			25.85	12.85		22.5	26.2		3.25	
Averages	*13.40*	*89.31*	*56.16*	*9.4*	*8.0*	*10.0*	*73*	*51*	*3.50*	*3.51*	*3.89*	*3.91*	*89.97*	*89.77*	*5.17*	*2.57*	*49.71*	*5.65*	*6.55*	*85.88*	*3.25*	
Minima	13.1	*89.3*	*54.9*	9.4	8.0	10.0	73	51	3.35	3.4	3.7	3.8	*83.5*	*88.3*	4.9	2.3	*46.9*	5.2	6.2	*79.1*	3.25	
Maxima	13.9	*89.3*	*58.3*	9.4	8.0	10.0	73	51	3.8	3.7	4.0	4.0	*95.0*	*92.5*	5.55	2.8	*52.8*	6.3	6.9	*91.9*	3.25	

ELDEN

339725	13.8	*93.5*	*56.5*	10.3	9.1	10.9	73	58	3.55	3.55	3.9	3.8	*91.0*	*93.4*	5.2	2.9	*55.8*	5.6	6.9	*81.2*	3.8	
339723	14.2	*88.7*	*52.1*	10.1	8.6	10.0	68	49	3.3	3.3	3.9	3.9	*84.6*	*84.6*	5.0	2.6	*52.0*	5.5	7.0	*78.6*	3.9	
339724					8.3	9.8			3.3	3.4	3.8	3.85	*86.8*	*88.3*	5.35	3.0	*56.1*				3.4	
339722	13.9	*82.0*	*51.8*	10.3	8.8	10.0	68	46	3.4	3.35	3.9	3.8	*87.2*	*88.2*	5.1	2.65	*52.0*				3.5	
339721	12.7					9.7			3.45	3.6	3.8	3.8	*90.8*	*94.7*	5.4	2.25	*41.7*				3.7	
339718									3.4		3.7		*91.9*		5.1	2.35	*46.1*	5.8	6.8	*85.3*	3.8	
339729															5.0	2.65	*53.0*	[2]5.6	6.9	*81.2*	3.6	
Number of skulls	(4)	(5)	(5)	(3)	(4)	(5)	(3)	(3)	(6)	(5)	(6)	(5)	(6)	(5)	(7)	(7)	(7)	(4)	(4)	(4)	(7)	
Totals	54.6			30.7	34.8	50.4			20.4	17.2	23.0	19.15			36.15	18.4		22.5	27.6		25.7	
Averages	*13.65*	*88.07*	*53.46*	*10.23*	*8.70*	*10.08*	*69*	*51*	*3.40*	*3.44*	*3.83*	*3.83*	*88.70*	*89.84*	*5.16*	*2.63*	*50.9*	*5.63*	*6.90*	*81.52*	*3.67*	
Minima	12.7	*82.0*	*51.8*	10.1	8.3	9.7	68	46	3.3	3.3	3.7	3.8	*84.6*	*84.6*	5.0	2.25	*41.7*	5.5	6.8	*78.6*	3.4	
Maxima	14.2	*93.5*	*56.5*	10.3	9.1	10.9	73	58	3.55	3.6	3.9	3.9	*91.9*	*94.7*	5.4	3.0	*56.1*	5.8	7.0	*85.3*	3.9	

CHAVES PASS

156996						[2]11.3																
157670						9.8				3.4		3.8		*89.5*	4.9	2.3	*46.9*					
158172	[2]13.6		*56.6*	10.2	8.6	10.2	69	48		3.8		4.0		*95.0*	5.3	2.45	*46.2*	5.6	[2]6.3	*88.9*		
157665	(13.7)		(*58.4*)	10.0	8.6	10.0	67	52	3.6	3.5	3.8	3.8	*94.7*	*92.1*	5.5	2.55	*45.4*	5.6	6.7	*83.6*		
157685									3.65	3.6	3.9	3.85	*95.6*	*92.5*	5.3	2.55	*48.1*					
157675	(13.6)		(*52.9*)	10.2	9.0	10.4	71	55	3.5	3.6	3.8	3.6	*92.1*	*100.0*	4.9	2.4	*49.0*	5.4	6.4	*84.4*		
158043	13.2		*56.8*	9.9	8.4	9.6	65	48	3.3	3.4	3.7	3.7	*89.2*	*91.9*	5.15	2.45	*47.6*	5.5	6.3	*87.8*		
157668	14.0		*53.6*	10.3	9.0	10.2	68	52	3.7	3.7	4.1	3.95	*90.2*	*93.7*	5.2	2.5	*48.1*	6.0	6.6	*90.9*		
158173						10.5																
158117	(14.2)				8.4	10.4			3.75	3.8	3.85	3.9	*97.4*	*97.4*	5.5	2.25	*40.9*					

[2] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—MALE—Continued

CHAVES PASS—Continued

Catalogue No.	Diam. Bizygomatic maxim. (c)	Facial Index, total $\left(\frac{a\times100}{c}\right)$	Facial Index, upper $\left(\frac{b\times100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	Orbital Index, right	Orbital Index, left	Nose, height	Nose, breadth maxim.	Nasal Index	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	Upper Alveolar Arch, Index	Lower Jaw, height at Symphysis
158109	[2] (13.5)	.....	(57.0)	(9.6)	(8.6)	(10.7)	(76)°	(61)°	.....	3.45	.....	3.95	.....	87.3	5.15	2.4	46.6	5.4	6.5	83.1	.....
158169	(13.5)	.....	.....	.....	9.2	10.4	.....	.....	3.35	3.4	4.05	3.9	82.7	83.9	5.1	2.2	43.1	.....	.....	.....	.....
157674	(13.5)	.....	(53.3)	9.5	8.2	9.7	70	53	3.35	3.5	3.9	3.9	85.9	89.7	4.8	2.9	60.4	.....	.....	.....	.....
157688	.....	.....	.....	.....	.....	9.5	.....	.....	.....	.....	.....	.....	.....	.....	5.4	2.4	44.4	.....	.....	.....	3.7
157681	13.1	.....	54.2	9.6	8.4	10.0	72	56	3.65	3.65	3.65	3.65	100.0	100.0	4.75	2.2	46.3	5.3	6.4	82.8	.....
157662	(14.3)	.....	(53.1)	10.0	8.6	10.4	71	49	3.6	3.5	3.75	3.75	96.0	93.3	5.45	2.6	47.7	5.8	6.8	85.3	.....
158171	13.1	.....	57.3	9.4	8.2	9.8	71	56	3.45	3.45	4.1	3.9	84.2	88.5	5.1	2.4	47.1	5.3	6.4	82.8	.....
157683	13.3	.....	51.1	.....	.....	.....	.....	.....	3.4	3.4	3.7	3.6	91.9	94.4	4.7	2.4	51.1	5.3	6.7	79.1	.....
Number of skulls	(6)	.....	(6)	(9)	(11)	(15)	(9)	(9)	(12)	(15)	(12)	(15)	(12)	(15)	(16)	(16)	(16)	(10)	(10)	(10)	(1)
Totals	80.3	.....	.....	89.1	94.6	151.9	.....	.....	42.3	53.15	46.3	57.25	.....	.....	82.2	38.95	.....	55.2	65.1	.....	3.7
Averages	*13.38*	.....	*54.92*	*9.90*	*8.60*	*10.15*	*69*	*52*	3.53	*3.54*	3.86	*3.82*	*91.36*	*92.84*	*5.14*	*2.43*	*47.38*	*5.52*	*6.51*	*84.79*	*3.7*
Minima	13.1	.....	*51.1*	9.4	8.2	9.2	65	48	3.3	3.4	3.65	3.6	*82.7*	*87.2*	4.7	2.2	*40.9*	5.3	6.3	*79.1*	3.7
Maxima	14.0	.....	*57.3*	10.3	9.2	11.3	72	56	3.75	3.8	4.1	4.0	*100.0*	*100.0*	5.5	2.9	*60.4*	6.0	6.8	*90.9*	3.7

PETRIFIED FOREST

213348	13.6	84.6	54.4	9.7	8.6	10.4	74	58	3.3	3.4	3.8	3.7	87.8	91.9	5.05	2.8	55.5	5.6	7.0	80.0	3.55
213316	13.2	98.5	58.3	10.7	9.0	10.2	65	47	.....	3.7	.....	3.6	.....	102.8	5.1	[2] 2.5	49.0	5.7	6.5	87.7	3.9
213343	13.9	.....	50.4	9.9	9.0	10.3	73	59	3.5	3.5	3.8	3.8	92.1	92.1	5.1	2.45	48.0	5.4	6.7	80.6	.....
213345	13.3	88.7	51.9	9.5	8.5	10.1	74	54	3.45	3.45	3.8	3.8	90.8	90.8	5.2	2.4	46.2	5.2	6.4	81.3	3.6
213342	13.4	85.1	51.5	10.1	8.7	10.1	70	46	3.4	3.4	3.8	3.7	89.5	91.9	5.0	2.45	49.0	5.5	6.3	87.3	3.7
213330	13.1	95.4	59.5	.....	.....	.....	.....	.....	3.8	3.8	3.5	3.5	108.6	103.6	5.2	2.2	42.3	5.2	6.5	80.0	3.7
213353	13.7	88.3	54.0	10.0	8.4	9.8	67	47	3.25	.....	3.7	.....	87.8	.....	5.05	2.55	50.5	5.7	[2] 7.0	81.4	3.4
213350	13.3	90.2	54.9	.....	.....	.....	.....	.....	3.45	3.15	3.95	3.8	87.3	82.9	5.1	2.7	52.9	5.9	7.3	80.8	3.3
213332	(13.9)	(87.1)	(52.5)	10.2	8.8	10.2	69	50	3.65	3.6	3.9	3.85	93.6	93.5	5.1	2.55	50.0	5.7	6.8	83.8	3.7
213310	.....	.....	.....	.....	.....	.....	.....	.....	3.65	3.65	3.65	3.6	100.0	101.4	5.7	2.35	41.2	5.7	6.7	85.1	3.5
213318	.....	.....	.....	.....	.....	9.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.7

213340	(14.4)	(86.8)	(52.7)	9.6	8.2	10.0	70	48	3.6	3.6	3.9	3.8	92.3	94.7	5.5	2.6	47.3	5.3	6.8	77.9	3.3
213317															5.1	2.3	45.1	5.5	[2] 6.6	83.3	
Number of skulls	(8)	(7)	(8)	(8)	(8)	(9)	(8)	(8)	(10)	(10)	(10)	(10)	(10)	(10)	(12)	(12)	(12)	(12)	(12)	(12)	(11)
Totals	107.5			79.7	69.2	90.8			35.05	35.25	37.8	37.15			62.2	29.85		66.4	80.6		39.35
Averages	*13.44*	*90.06*	*54.33*	*9.96*	*8.65*	*10.09*	*70*	*51*	*3.51*	*3.53*	*3.78*	*3.72*	*92.72*	*94.89*	*5.18*	*2.49*	*47.99*	*5.53*	*6.72*	*82.38*	*3.58*
Minima	13.1	84.6	50.4	9.5	8.2	9.7	65	46	3.25	3.15	3.5	3.5	86.8	82.9	5.0	2.2	41.2	5.2	6.3	77.9	3.3
Maxima	13.9	98.5	59.5	10.7	9.0	10.4	74	59	3.8	3.8	3.95	3.85	108.6	108.6	5.7	2.8	55.5	5.9	7.3	87.7	3.9

MISCELLANEOUS

213299	13.3		54.9	10.0	8.6	10.1	76	52	3.4	3.45	3.8	3.9	89.5	88.5	4.85	2.6	53.6	5.6	6.3	88.9	
213305	13.9		51.1	10.5	9.2	10.4	76	50		3.45		3.85		89.6	5.1	[2] 2.4	47.1				
213306	13.1		58.0						3.5	3.5	4.0	3.9	87.5	89.7	5.2	2.4	46.2	5.3	6.2	85.5	
213285	13.3		55.6	9.8	8.6	10.0	70	55	3.25	3.4	3.7	3.6	87.8	94.4	5.0	2.2	44.0	5.7	6.4	89.1	
213304	[2](14.2)		(54.2)						3.4	3.4	3.65	3.6	93.2	94.4	5.3	2.7	50.9	5.3	[2] 6.2	85.5	
213291	13.6		52.9	9.2	7.9	9.4	69	52	3.5	3.5	3.7	3.6	94.6	97.2	4.9	2.3	46.9	5.4	6.8	79.4	
213293	(14.2)		(50.7)			(10.0)			3.6	3.5	4.1	4.2	87.8	83.3	4.95	2.5	50.5	5.6	6.8	82.4	
246970	(14.5)	(83.5)	(58.1)						3.65	3.7	4.0	3.9	91.3	94.9	5.6	2.65	47.3	5.8	6.8	85.3	3.5
246965	[2] 14.3	93.7	55.9	10.1	8.4	9.9	65	47	3.25	3.25	3.75	3.7	86.7	87.8	5.35	2.4	44.9	5.8	6.5	89.2	4.0
246988	(13.7)		(52.6)	9.9	8.6	9.8	68	50	3.6		3.8		94.7		5.1	2.45	48.0				3.4
246991				9.1	8.6	9.4	69	57	3.4	3.4	3.8	3.8	89.5	89.5	4.75	2.45	51.6	4.9	6.0	81.7	3.2
246995									3.9	3.9	4.0	4.0	97.5	97.5	5.4	2.45	45.4	5.4	6.6	81.8	
246989				10.1	8.8	10.0	69	51	3.6	3.6	3.85	3.85	93.5	93.5	5.2	2.65	51.0	5.8	6.3	92.1	3.6
176949	(14.5)		(53.8)						3.4	3.4	3.9	3.8	87.2	89.5	5.1	2.7	52.9	[2] 5.7	7.2	79.2	
176939	(14.2)	(82.4)	(52.1)	9.7	8.5	9.9	70	54	3.4	3.5	3.9	3.9	87.2	89.7	5.2	2.65	51.0	5.1	6.4	79.7	3.5
176941									3.3	3.3	4.0	3.9	82.5	84.6	5.05	2.7	53.5	5.5	[2] 6.5	84.6	3.6
176950	(13.5)		(53.3)						3.2	3.15	3.75	3.85	85.3	81.8	4.7	2.2	46.8	4.9	5.9	83.1	
177874															5.0	2.2	44.0				3.7
177873	[2] 13.3		60.9						3.55	3.4	3.8	3.9	93.4	87.2	5.45	2.75	50.5	5.8	6.4	90.6	4.0
177875									3.55	3.55	3.9	3.9	91.0	91.0	5.4	2.4	44.4	5.1	7.0	72.9	3.6
270460	14.2	88.7	53.5	10.0	8.7	10.0	68	51	3.4	3.4	3.9	3.9	87.2	87.2	5.35	2.4	44.9	5.3	6.3	84.1	3.6
270465	12.7	89.8	55.1	(9.3)	[2] (8.0)	[2] (9.4)	(69)	(50)	3.55	3.5	3.4	3.5	104.4	100.0	4.9	2.5	51.0	5.2	6.1	85.3	3.35
270463	(13.5)	(94.1)	(55.6)		8.8	10.6									5.2	2.55	49.0				3.55
157385	13.6	91.9	54.4	10.3	8.6	9.9	66	45	3.3	3.3	3.9	3.7	84.6	89.2	4.95	2.55	51.5	5.6	6.7	83.6	3.9
243903	(14.9)				9.1	10.2			3.7	3.8	4.2	4.0	88.1	95.0	5.35	2.7	50.5				
213356	13.0		55.4	9.8	8.2	9.6	67	46	3.6	3.6	3.8	3.8	94.7	94.7	4.95	2.6	52.5	5.6	6.6	84.9	
336959	13.0	94.6	56.9	10.0	8.9	10.2	70	59	3.3	3.4	3.8	3.7	86.8	91.9	4.9	2.45	50.0	5.9	6.6	89.4	3.9
229364	14.1	87.9	52.5	10.0	8.5	9.6	65	46	3.65	3.6	3.65	3.7	100.0	97.3	5.2	2.85	54.8	5.6	7.1	78.9	3.8
300010	(14.0)		(55.0)	[2] 9.6	8.4	9.9	69	54	3.6	3.55	3.8	3.8	94.7	93.4	5.4	2.45	45.4	[2] 5.5	6.7	82.1	3.5
213327	13.7	85.4	50.4	9.4	8.4	10.4	78	57	3.4	3.35	3.7	3.65	91.9	91.8	4.95	2.6	52.5	5.2	6.2	83.9	3.25
243823	(14.2)		(49.3)	(9.0)	(7.8)	(9.4)	(71)	(51)	3.5	3.5	3.7	3.7	94.6	94.6	5.0	2.35	47.0	5.0	6.2	80.7	

[1] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—MALE—Continued

MISCELLANEOUS—Continued

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length, maxim.	Upper Alveolar Arch, breadth maxim	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
257536	14.2	*82.4*	*52.1*	(9.6)	(8.3)	(9.8)	(70)	(70)	3.65	3.55	4.0	4.1	*91.3*	*86.6*	5.3	2.6	*49.1*	5.5	6.9	*79.7*	3.2
243821	.....	.....	.....	.....	9.1	10.5	.....	.....	3.4	3.4	3.95	.....	*86.1*	.....	3.3	2.7	*81.8*	.....	.....	.....	.....
Number of skulls	(15)	(8)	(15)	(16)	(19)	(19)	(16)	(16)	(30)	(30)	(30)	(29)	(20)	(29)	(35)	(37)	(23)	(27)	(27)	(27)	(19)
Totals	203.3	.....	.....	157.5	163.3	189.8	.....	.....	104.5	104.3	115.2	110.7	.....	.....	167.35	83.05	.....	147.1	175.7	.....	68.15
Averages	*13.55*	*89.25*	*54.60*	*9.84*	*8.59*	*9.99*	*69*	*52*	*3.48*	*3.48*	*3.84*	*3.82*	*90.71*	*91.15*	*5.07*	*2.52*	*49.63*	*5.45*	*6.51*	*83.72*	*3.59*
Minima	12.7	*82.4*	*50.4*	9.1	7.9	9.4	65	45	3.2	3.15	3.4	3.5	*82.5*	*81.8*	3.3	2.2	*44.0*	4.9	5.9	*72.9*	3.2
Maxima	14.3	*94.6*	*60.9*	10.5	9.2	10.6	78	59	3.9	3.9	4.2	4.2	*104.4*	*100.0*	5.6	2.85	*81.8*	5.9	7.2	*92.1*	4.0

DEFORMED COLORADO CRANIA.—MALE

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
315955	B. A. E., J. W. Fewkes.	Mesa Verde	50	Pronounced	(16.7)	(15.0)	(14.6)	(89.8)	(92.1)	(97.3)	15.43	1,560	Moderate	11.5	7.0
315954	do	do	30	do	(16.4)	(15.4)	(15.4)	(93.9)	(96.9)	(100.0)	15.73	1,480	No wear	13.2	7.9
336621	B. A. E.	Montezuma Canyon	50	Medium	(16.4)	(15.6)	(14.5)	(95.1)	(90.6)	(93.0)	15.59	[2] 1,400	Medium	13.0	7.9
Number of skulls											(3)	(3)		(3)	(3)
Totals											46.66	4,440		37.7	22.8
Averages											*15.55*	*1,480*		*12.57*	*7.60*
Minima											15.43	1,400		11.5	7.0
Maxima											15.73	1,560		13.2	7.9

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, Breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
							°	°													
315,955	(14.1)	*(81.6)*	*(49.6)*	10.0	8.7	10.2	71	49	3.35	3.4	4.0	4.0	*82.5*	*85.0*	5.0	2.4	*48.0*				3.3
315,954				(9.2)	(8.2)	(10.0)	(71)	(60)	3.35	3.4	3.9	3.9	*85.9*	*87.2*	5.4	2.7	*50.0*	5.2	7.1	*73.2*	4.0
336,621	13.8	*94.2*	*57.3*	9.6	8.3	10.1	70	55	3.4	3.4	3.7	3.9	*91.9*	*87.2*	5.2	2.7	*51.9*	5.5	7.0	*78.6*	3.9
Number of skulls	(1)	*(1)*	*(1)*	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(3)	(3)	*(3)*	*(3)*	(3)	(3)	*(3)*	(2)	(2)	*(2)*	(3)
Totals	13.8			19.6	17.0	20.3			10.1	10.2	11.6	11.8			15.6	7.8		10.7	14.1		11.2
Averages	*13.8*	*94.20*	*57.25*	*9.80*	*8.50*	*10.15*	*71*	*53*	*3.37*	*3.40*	*3.87*	*3.93*	*87.07*	*86.44*	*5.20*	*2.60*	*50.0*	*5.35*	*7.05*	*75.89*	*3.73*
Minima	13.8	*94.20*	*57.3*	9.6	8.3	10.1	70	49	3.35	3.4	3.7	3.9	*83.5*	*85.0*	5.0	2.4	*48.0*	5.2	7.0	*73.2*	3.3
Maxima	13.8	*94.20*	*57.3*	10.0	8.7	10.2	71	55	3.4	3.4	4.0	4.0	*91.9*	*87.2*	5.4	2.7	*51.9*	5.5	7.1	*78.6*	4.0

[2] Near.

PUEBLOS—Continued

DEFORMED NEW MEXICO CRANIA.—FEMALE

PUYÉ

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
262268	E. L. Hewett	Puyé	Adult	Moderate	(16.0)	13.1	12.8	(81.9)	(88.0)	97.7	13.97	1,120	Slight	11.4	7.1
262281	do	do	40	Slight	(15.1)	(12.7)	(13.0)	(84.1)	(93.5)	(102.4)	13.60	1,100	Moderate	12.0	7.2
262921	do	do	Adult	Medium asymmetry	(16.0)	(13.6)	12.6	(85.0)	(85.1)	(92.7)	14.07	1,165			6.8
262252	do	do	do	Moderately occipital	(15.0)	(13.0)	(13.0)	(86.7)	(92.9)	(100.0)	13.67	1,010	Medium	11.5	7.2
263013	do	do	55	Considerable	(15.4)	(13.4)	(12.6)	(87.0)	(87.5)	(94.0)	13.80	1,075	Moderate	11.7	6.9
262995	do	do	Adult	Moderate	(15.4)	(13.6)	13.2	(88.3)	(91.0)	(97.1)	14.07	1,165		11.9	6.9
262963	do	do	do	Marked lateral compression.	(15.9)	(14.2)	13.0	(89.3)	(86.4)	(91.6)	14.37	1,185		11.0	(6.4)
262069	do	do	do	Slight occipital compression.	(15.0)	(13.4)	(13.0)	(89.3)	(91.6)	(97.0)	13.80	1,140	Medium	11.1	6.9
269230	do	do	40	Considerable	(15.2)	(13.6)		(89.5)					Very slight	10.8	6.5
262264	B. A. E. and S. A. A.	do	Adult	Moderate asymmetry	(15.3)	(13.8)	13.4	(90.2)	(92.1)	(97.1)	14.17	1,205			(6.4)
262996	S. A. A., E. L. Hewett.	do	do	Medium occipital compression.	(15.2)	(13.8)	(13.6)	(90.8)	(93.8)	(98.6)	14.20	1,240	Moderate	9.9	6.1
263095	do	do	do	Moderate occipital compression.	(15.2)	(13.8)		(90.8)				(1,190)	Slight	11.1	6.8
269285	E. L. Hewett	do	20	Medium	(15.2)	(13.8)	(12.7)	(90.8)	(87.6)	(92.0)	13.90	1,190	No wear	9.9	6.0
262986	S. A. A., E. L. Hewett.	do	Adult	Moderate occipital compression.	(15.4)	(14.1)	(13.3)	(91.6)	(90.2)	(94.3)	14.27	1,290		10.9	6.8
263053	E. L. Hewett	do	50	Medium	(14.7)	(13.5)	(12.9)	(91.8)	(91.5)	(95.6)	13.70	1,105	Moderate	10.7	6.5
263038	S. A. A., E. L. Hewett.	do	Adult	Slight occipital compression.	(15.3)	(14.1)	13.0	(92.2)	(88.4)	(92.2)	14.13	1,190	Medium	10.0	6.2
269299	B. A. E. and S. A. A.	do	do	Moderate occipital compression.	(15.1)	(14.0)	12.2	(92.7)	(83.9)	(87.1)	13.77	(1,175)			
269286	E. L. Hewett	do	50	Medium	(15.2)	(14.1)	(13.6)	(92.8)	(92.8)	(96.5)	14.30	1,250			
262998	S. A. A., E. L. Hewett.	do	Adult	Marked occipital compression.	(15.1)	(14.2)	(13.4)	(94.0)	(91.5)	(94.4)	14.23	1,140		11.8	7.1
269252	do	do	do	Moderate occipital compression.	(15.4)	(14.5)	12.9	(94.2)	(86.3)	(89.0)	14.27	1,250	Slight	11.4	7.1
262918	do	do	do	do	(15.0)	(14.4)	(13.6)	(96.0)	(92.5)	(94.4)	14.33	(1,225)			

263034	....do....	....do....	...do...	Marked occipital compression.	(14.8)	(14.2)	(13.6)	(96.0)	(93.8)	(95.8)	14.20	1,225	.....	11.2	6.7
263015	....do....	....do....	...do...	Moderate occipital compression.	(16.0)	(15.4)	(13.4)	(96.3)	(85.4)	(87.0)	14.93	1,310	.....	.....	6.9
263054	E. L. Hewett	....do....	Near 20.	Pronounced	(14.6)	[2](14.2)	(12.8)	(97.3)	(88.9)	(90.1)	13.87	.....	No wear	10.4	6.5
262913	S. A. A., E. L. Hewitt.	....do....	Adult.	Marked occipital	(14.9)	(14.6)	(11.2)	(98.0)	(96.3)	(97.3)	14.57	1,275	.....	.....	6.6
263093	....do....	....do....	...do...	....do....	(15.3)	(15.0)	(13.8)	(98.0)	(91.1)	(92.0)	14.70	1,350	.....	11.1	7.1
263041	....do....	....do....	...do...	....do....	(14.7)	(14.6)	(12.8)	(99.3)	(87.4)	(87.7)	14.03	1,160	Slight	10.9	6.7
262977	....do....	....do....	60	Considerable	(14.5)	(15.0)	(13.9)	(103.5)	(94.2)	(92.7)	14.47	.....	Medium	11.2	6.8
263055	....do....	....do....	Adult.	Slight	(16.1)	.....	.....	.....	.....	.....	.....	1,210	....do....	11.7	7.2
263026	....do....	....do....	...do...	Marked	(14.4)	.....	(14.0)	.....	.....	.....	.....	.....	Moderate	10.8	6.6
Number of skulls					.....	(1)	(8)	.....	.....	(1)	(26)	(23)	.....	(23)	(25)
Totals					.....	13.1	103.1	.....	.....	.....	367.39	27,320	.....	254.4	169.2
Averages					.....	*13.1*	*12.89*	.....	.....	*97.7*	*14.13*	*1,188*	.....	*11.06*	*6.77*
Minima					.....	.....	12.2	.....	.....	.....	13.60	1,010	.....	9.9	6.0
Maxima					.....	.....	13.4	.....	.....	.....	14.93	1,350	.....	12.0	7.2

OTHER TÉWA AND MISCELLANEOUS

229024	E. L. Hewett	Otowi	60	Pronounced	(16.8)	(13.8)	.....	(82.1)	.....	.....	.....	.....	.....	.....	[2]6.5
228677	....do....	....do....	55	Slight	(16.3)	(13.6)	(13.9)	(83.4)	(94.0)	(102.2)	14.60	1,225	.....	.....	[2]6.4
228801	....do....	....do....	45	Considerable	(16.4)	(13.7)	(13.6)	(83.5)	(90.4)	(99.3)	14.57	.....	Moderate	11.1	6.8
228918	....do....	....do....	Adult.	Moderate	(15.1)	(13.2)	13.2	(87.4)	(93.3)	(100.0)	13.83	1,070	.....	11.2	7.0
228625	....do....	....do....	35	....do....	(15.4)	[2](13.6)	(13.)	(88.3)	(93.8)	(100.6)	14.20	.....	Very slight	11.0	6.6
228663	....do....	....do....	50	Medium	(14.9)	(14.7)	.....	(98.7)	.....	.....	.....	.....	.....	.....	7.2
271912	B.A.E. and S.A.A.	Kwasteyukwa, Jemez	45	Medium lateral	(16.4)	(13.7)	(13.2)	(83.5)	(87.7)	(96.4)	14.43	.....	Moderate	11.5	7.1
271811	....do....	....do....	Adult.	....do....	(16.0)	(13.6)	(13.3)	(85.0)	(89.9)	(97.8)	14.30	1,240	.....	.....	6.4
271816	....do....	....do....	...do...	Moderate lateral	(16.0)	(13.6)	12.8	(85.0)	(86.5)	(94.1)	14.13	1,190	.....	11.1	6.4
271804	....do....	....do....	35	Moderate	(15.6)	(13.3)	(13.3)	(85.3)	(92.0)	(100.0)	14.07	1,145	No wear	10.9	6.7
271910	....do....	....do....	30	Slight	(15.9)	(13.6)	(13.1)	(85.5)	(88.1)	(95.6)	14.17	1,240	.....	.....	.....
271813	....do....	....do....	Adult.	Medium	(15.6)	(13.8)	13.0	(88.5)	(88.4)	(94.2)	14.13	1,225	.....	12.2	7.7
271802	....do....	....do....	50	....do....	(16.0)	(14.2)	(13.9)	(88.8)	(92.1)	(97.9)	14.70	1,315	Moderate	10.4	6.5
271812	....do....	....do....	Adult.	Moderate asymmetry	(16.2)	(14.5)	13.1	(89.5)	(85.3)	(90.3)	14.60	1,295	.....	10.0	6.4
271906	....do....	....do....	55	Medium lateral	(15.8)	(14.3)	(13.2)	(90.5)	(87.7)	(92.3)	14.13	1,215	Moderate	12.1	7.5
271858	....do....	....do....	60	Slight	(15.6)	(14.5)	[2](12.6)	(93.0)	(83.7)	(86.9)	14.23	.....	.....	.....	.....
271809	....do....	....do....	35	Medium	(15.4)	(14.4)	.....	(93.5)	.....	.....	.....	[2]1,280	Very slight	10.6	6.6
271902	....do....	....do....	55	....do....	(15.6)	(14.6)	(13.4)	(93.6)	(88.7)	(91.8)	14.53	(1,190)	Medium	11.4	7.1
271801	....do....	....do....	60	Pronounced	(15.2)	(14.4)	(13.5)	(94.7)	(91.2)	(93.8)	14.37	1,180	Lowers moderate; uppers considerable.	11.0	6.8
271883	....do....	....do....	24	....do....	(15.3)	(15.0)	(13.7)	(98.0)	(90.4)	(91.3)	14.67	1,360	No wear	11.3	7.3
271900	....do....	....do....	60	....do....	(15.0)	(14.8)	(13.8)	(98.7)	(92.6)	(93.2)	14.53	(1,230)	.....	.....	7.2
271810	....do....	....do....	60	....do....	[2](14.4)	(15.0)	(13.4)	(104.2)	(91.2)	(89.3)	14.27	.....	.....	.....	6.8

[2] Near.

PUEBLOS—Continued

DEFORMED NEW MEXICO CRANIA.—FEMALE—Continued

OTHER TÉWA AND MISCELLANEOUS—Continued

Catalogue No.	Collection	Locality	Age	Deformation	Diameter, basion-bregma, maximum	Diameter, transverse, maximum	Basion-bregma height	Cranial index	Mean height index	Height-breadth index	Cranial capacity	Capacity, by Manouvrier's method	Teeth, wear	Mandible, bigonial breadth	Palate, breadth
274049	B. A. E. and S. A. A.	Kwastoyukwa, Jemez	25	Moderate									No wear	11.5	7.0
274903	....do	....do	30	Slight to moderate		(13.9)	(12.4)			(89.2)			do	[2] 11.1	[2] 6.9
269210	do	Giusewa	Adult	Moderate—circumoccipital	(15.4)	(13.9)	(13.7)	(90.3)	(89.1)	(95.0)	14.17	1,220			
269207	do	....do	do	....do	(15.7)	(14.1)	(13.7)	(91.7)	(87.7)	(91.7)	14.43	1,185		10.5	6.3
269203	do	....do	do	Slight	(15.6)	(14.6)	(14.2)	(97.4)	(90.9)	(92.1)	14.93	1,450	Medium	11.8	7.1
[illegible]	E. L. Hewett	Tshirege	55	Moderate	(15.8)	(13.6)		(86.1)				[1] 1,075			6.9
[illegible]	do	....do	40	Slight	(15.1)	(13.4)	(12.6)	(88.7)	(83.4)	(94.0)	13.70	[1] 1,110	Medium		6.3
[illegible]	do	....do	55	Medium	(15.0)	(13.7)	(13.4)	(91.3)	(93.4)	(97.8)	14.03		do	10.9	6.7
228207	do	do	Adult	Medium lateral	(15.4)	(14.1)	(13.7)	(91.6)	(92.9)	(97.2)	14.46	1,150			6.6
228027	do	do	24	Medium	(15.2)	(14.6)	(14.3)	(96.1)	(94.7)	(98.6)	14.10	1,265			7.0
228226	do	do	25	Pronounced	(15.6)	(15.0)	(14.4)	(96.1)	(92.4)	(96.0)	15.00	1,275			
228276	do	Rito de los Frijoles	24	[illegible]									No wear	10.9	6.7
327067	N. M. Judd, N. G. S.	Pueblo Bonito	Adult	Moderate	(16.4)	(14.6)	(14.1)	(89.0)	(86.0)	(96.6)	15.13	1,310	Medium	12.1	7.1
327116	do	do	do	Marked	(17.0)	(15.7)	(14.5)	(92.3)	(85.2)	(92.4)	16.60	1,370			6.4
327115	do	....do	....do	Moderate	(16.6)	(14.8)	13.1	(89.5)	(85.1)	(88.4)	14.93	1,180			
327070	....do	do	do	Marked	(16.6)	(15.3)	(13.6)	(95.6)	(89.9)	(89.9)	14.97	1,230			6.3
331219	do	Chaco Canyon	Near 20	Moderate	(16.0)	(13.9)	(12.6)	(84.3)	(80.3)	(90.9)	13.87	[illegible]			6.4
327140	do	....do	Adult	Medium	(16.6)	(14.6)	[illegible]	(88.0)	[illegible]	[illegible]		(1,465)			7.0
324684	....do	....do	25	do	(15.6)	(14.0)	(13.1)	(89.7)	(88.5)	(93.6)	14.23	1,125	No wear	10.5	6.7
24161	R. S. Vickery	Fort Wingate	60	do	(16.2)	(14.8)	(13.9)	(91.4)	(89.7)	(94.2)	14.97	1,465	Considerable		7.0
314272	J. V. Jemeon	Moquim	15	Pronounced	(14.7)	(14.2)	(13.0)	(97.3)	(89.7)	(90.9)	14.60	1,190	Moderate	9.9	6.3
314271	do	do	60	do	(14.7)	(13.6)	(13.1)	(103.5)	(88.8)	(87.3)	14.20	1,110	Nearly all lost	[illegible]	[illegible]
227414	W. H. Nelson	Upper San Francisco River.	40	Medium									Very slight	11.5	7.2

339697	B. I. Staples	Coolidge	35	Moderate	(16.2)	(14.0)	(12.9)	(86.4)	(85.4)	(92.1)	14.37	1,170	No wear	11.0	6.9
286301	J. W. Fewkes	Lower Mimbres	20	do	(15.5)	(13.8)	(13.7)	(89.0)	(98.5)	(99.5)	14.33	1,370		10.9	6.2
317193	N. M. Judd	Manuelito	30	Medium lateral	(15.4)	(13.9)	(13.6)	(90.3)	(92.8)	(97.8)	14.30	1,295	No wear	10.4	6.6
317195	do	do	40	Pronounced	(16.3)	(17.2)	(15.6)	(93.3)	(95.2)	(98.7)	15.50	(1,530)	Moderate	11.1	7.1
Number of skulls							(5)				(40)	(33)		(28)	(43)
Totals							65.2				577.62	41,135		310.5	291.6
Averages							*13.04*				*14.44*	*1,247*		*11.09*	6.78
Minima							12.8				13.70	1,070		9.9	5.6
Maxima							13.2				15.60	1,530		12.2	7.7

OLD ZUÑI

308607	F. W. Hodge	Havikuh	Adult	Moderate asymmetry	(17.7)	(13.5)		(76.3)							6.6
314318	do	do	do	Moderate lateral	(17.1)	(13.6)	(13.8)	(79.5)	(89.9)	(101.5)	(14.83)	1,305	Moderate	11.8	7.6
326193	do	do	40	do	(16.3)	(13.0)	(12.9)	(79.8)	(88.7)	(99.2)	(14.07)	1,110	Sheht	11.4	6.8
308633	do	do	Adult	Very asymmetrical	(15.7)	(12.7)		(80.9)				1,025	Medium	10.9	6.3
308644	do	do	do	Marked lateral compression.	(15.2)	(12.4)	(13.5)	(81.6)	(97.8)	(108.9)	(13.70)	1,090		10.3	6.5
332499	do	do	do	Moderate occipital compression.	(17.0)	(14.0)	(14.0)	(82.4)	(96.8)	(100.6)	(15.00)	1,340		10.8	7.0
308622	do	do	do	do	(15.9)	(13.4)	(13.7)	(84.8)	(93.5)	(102.9)	(14.33)	1,265	Considerable	10.3	6.4
314281	do	do	do	Moderate asymmetry	(15.4)	(13.2)	13.4	(85.7)	(96.7)	(101.5)	(14.00)	1,120	Medium	10.8	6.9
308649	do	do	do	Occipital compression	(16.1)	(14.0)	13.5	(87.0)	(89.7)	(96.4)	(14.53)	1,125		10.3	6.3
314309	do	do	Young adult.	Moderate occipital compression.	(15.8)	(13.8)	12.6	(87.3)	(85.1)	(91.3)	(14.67)	1,145		10.4	5.9
308611	do	do	Adult	Marked occipital compression.	(15.6)	(14.2)	(13.7)	(91.6)	(92.0)	(96.5)	(14.50)	1,330		11.9	(6.6)
308741	do	do	do	Moderate asymmetry	(16.0)	(14.6)	13.2	(91.3)	(86.3)	(90.4)	(14.60)	1,400	Slight	11.3	6.6
308618	do	do	do	Moderate occipital compression.	(15.3)	(14.0)	(13.4)	(91.5)	(94.5)	(99.7)	(14.25)	1,175		10.6	6.4
308679	do	do	do	do	(15.6)	(14.3)		(91.7)				(1,235)	Slight	11.7	7.3
308723	do	do	do	do	(15.1)	(13.9)	(13.6)	(92.1)	(94.3)	(97.8)	(14.20)	1,230		11.3	6.8
308635	do	do	do	do	(14.2)	(13.8)	(13.6)	(97.2)	(92.9)	(94.3)	(13.67)	1,120		11.8	7.0
308642	do	do	do	do											
314282	do	do	do	Marked post mortem deformation.											
Number of skulls							(4)				(13)	(14)		(15)	(15)
Totals							52.7				185.73	16,780		165.6	100.4
Averages							*13.18*				*14.29*	*1,199*		*11.04*	*6.69*
Minima							12.6				13.67	1,025		10.3	5.9
Maxima							13.8				15.00	1,340		11.9	7.6

[2] Near.

PUEBLOS—Continued

DEFORMED NEW MEXICO CRANIA.—FEMALE—Continued

PUYE

Catalogue No.	Diam. Bizygomatic maxim. (c)	Facial Index, total $\left(\frac{a \times 100}{c}\right)$	Facial Index, upper $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	Orbital Index, right	Orbital Index, left	Nose, height	Nose, breadth maxim.	Nasal Index	Upper Aveolar Arch, length, maxim.	Upper Alveolar Arch, breadth maxim	Upper Alveolar Arch, Index	Lower Jaw, height at Symphysis
262968				9.1	8.2	9.8	° 74	° 60	3.4		3.5	3.8	*97.1*		5.0	2.4	*48.0*	4.9	5.9	*83.1*	3.2
269281	11.9	*100.8*	*60.5*	9.5	8.0	8.8	62	47	3.6	3.4	3.6	3.5	*100.0*	*97.1*	4.9	2.5	*51.0*	5.4	5.9	*91.5*	3.9
262921	12.0		*56.7*	9.0	7.6	8.7	65	47							4.7	2.5	*53.2*				
262952	12.3	*93.5*	*58.5*	9.4	8.4	9.7	70	57		3.3		3.7		*89.2*	5.1	2.5	*49.0*	5.1	6.2	*82.3*	3.1
263013	13.0	*90.0*	*53.1*	10.3	8.6	9.6	65	42	3.5	3.4	3.6	3.5	*97.2*	*97.1*	4.7	2.4	*51.1*				3.5
262995	12.8	*93.0*	*53.9*	9.2	8.2	9.2	68	58	3.2	3.2	3.6	3.6	*88.9*	*88.9*	4.6	2.5	*54.4*	5.1	6.3	*81.0*	3.8
262963	12.4	*88.7*	*(51.6)*	(8.9)	(7.9)	(8.9)	(69)	(54)	3.3	3.45	3.55	3.4	*93.0*	*101.5*	4.6	2.3	*50.0*	4.9	5.6	*87.5*	
262009	12.6	*88.1*	*54.8*	9.0	7.7	8.8	66	49	3.5	3.45	3.75	3.7	*93.4*	*93.2*	4.8	2.6	*54.2*	5.1	6.0	*85.0*	3.2
269230									3.4	3.5	3.5	3.7	*97.1*	*94.6*	4.45	2.35	*53.8*	5.3	6.1	*86.9*	3.1
269294	12.8		*(50.0)*	(8.4)	7.8	9.3	(77)	(63)	3.35	3.1	3.65	3.7	*91.8*	*83.8*	4.9	2.5	*51.0*				
262996	12.9	*76.7*	*47.3*	9.0	8.0	9.5	75	52	3.3	3.5	3.7	3.6	*89.2*	*97.2*	4.5	2.5	*55.6*	4.8	4.9	*98.0*	
263095	12.5	*88.8*	*54.4*						(3.6)	(3.6)	(3.6)	(3.5)	*(100.0)*	*(102.9)*	4.7	2.3	*48.9*				3.4
269285	12.3	*80.5*	*48.8*	8.3	7.5	9.2	73	54		3.2		3.7		*86.5*	4.6	2.3	*50.0*	4.7	5.5	*85.5*	2.6
262986	12.7	*85.8*	*53.5*	(9.1)	(8.0)	(9.2)	(6?)	(51)							5.0	2.3	*46.0*	5.3	6.0	*88.3*	3.2
263053	(13.1)	*(81.7)*	*(49.6)*	8.6	7.6	8.8	70	55	3.2	3.2	3.5	3.45	*91.4*	*92.8*	4.6	2.5	*54.4*	4.8	[2]5.9	*81.4*	2.95
263038				9.4	8.5	9.3	70	54	3.35	3.3	3.7	3.7	*90.5*	*89.2*	4.6	2.5	*54.4*	5.2			2.9
269299	12.4			8.8	7.6													5.0	5.8	*86.2*	
269286	12.8					9.1				3.25		3.7		*87.8*							3.6
262998	13.0	*90.8*	*54.6*	9.7	8.3	9.5	67	51	3.4	3.6	3.7	3.7	*91.9*	*97.3*	4.7	2.5	*53.2*	5.5	6.3	*87.3*	3.8
269252	13.1	*87.0*	*54.2*	9.3	8.0	9.1	67	50	3.3	3.5	3.7	3.8	*89.2*	*92.1*	5.0	2.6	*52.0*	5.2	6.2	*83.9*	3.3
262918	(13.0)																				
263034	12.9	*86.8*	*51.9*						(3.4)	(3.7)	(3.7)	(3.6)	*(91.9)*	*(102.8)*	4.9	2.5	*51.0*				
263015	13.2		*52.3*	9.3	8.1	9.5	70	54	3.3	3.4	3.8	3.7	*86.8*	*91.9*	4.6	2.4	*52.2*	5.4	6.1	*88.5*	
263054	12.5	*83.2*	*52.0*	9.1	7.8	8.8	67	48	3.5	3.6	3.6	3.5	*97.2*	*102.9*	4.45	2.6	*58.4*	5.2	6.2	*83.9*	2.7
262913				(9.2)	(8.0)	(9.1)	(68)	(48)	3.3	3.45	3.75	3.5	*88.0*	*98.6*	4.8	2.4	*50.0*	5.3	6.3	*84.1*	
263093				9.3	8.1	9.7	71	56	(3.5)	(3.6)	(3.7)	(3.8)	*(94.6)*	*(94.7)*	4.9	2.6	*53.1*	5.0	6.2	*80.7*	3.2
263041	(13.1)	*(83.2)*	*(51.2)*	(8.8)	(7.8)	(9.0)	(70)	(56)	3.3		3.7	3.6	*89.2*		4.7	2.4	*51.1*	5.0	6.3	*79.4*	3.3
263277				(8.9)	(7.7)	(9.4)	(72)	(49)	3.35		3.65		*91.8*		5.0	2.7	*54.0*				3.1
263055									3.5		3.9		*89.7*		5.0	2.6	*52.0*	5.8	5.9	*98.3*	
263026															4.5	2.4	*53.3*	5.2	6.0	*86.7*	3.4

Number of skulls	(19)	(14)	(15)	(17)	(18)	(18)	(16)	(16)	(19)	(18)	(19)	(20)	(19)	(18)	(27)	(27)	(27)	(22)	(21)	(21)	(20)
Totals	240.1			156.3	144.0	166.4			64.05	60.8	69.45	72.55			128.3	66.65		113.2	125.6		65.55
Averages	*12.64*	*88.07*	*53.72*	*9.19*	*8.00*	*9.24*	*69*	*52*	*3.57*	*3.38*	*3.66*	*3.63*	*92.22*	*93.32*	*4.75*	*2.47*	*51.94*	*5.15*	*5.98*	*85.99*	*3.38*
Minima	11.9	*76.7*	*47.3*	8.3	7.5	8.7	62	42	3.2	3.1	3.5	3.4	*86.8*	*83.8*	4.45	2.3	*46.6*	4.7	4.9	*79.4*	2.6
Maxima	13.2	*100.8*	*60.5*	10.3	8.6	9.8	75	60	3.6	3.6	3.9	3.8	*100.0*	*102.9*	5.1	2.7	*58.4*	5.8	6.3	*98.3*	3.9

OTHER TEWA AND MISCELLANEOUS

229024									3.1	3.05	3.55	3.55	*87.3*	*85.9*	4.6	2.5	*54.4*	[2] 5.3	6.4	*82.8*	
228977	12.9		*49.6*	9.6	8.4	9.8	73	45	3.6	3.6	3.75	3.7	*96.0*	*97.3*	4.8	2.5	*52.1*	5.2	[1] 6.2	*83.9*	
228901	[2] 13.1	*84.7*	*51.9*	9.5	8.4	9.8	72	55	3.5		3.9		*89.7*		4.65	2.2	*47.3*	5.1	5.9	*86.4*	3.3
228918	12.3	*91.1*	*56.9*	9.5	8.4	9.6	69	55	3.3	3.2	3.5	3.5	*94.3*	*91.4*	4.8	2.9	*60.4*	5.5	6.5	*84.6*	3.4
228925	[2] 12.8	*85.9*	*51.6*	10.1	8.8	9.6	67		3.15		3.65		*86.3*								3.3
228963									3.35		3.45		*97.1*		4.9	2.3	*46.9*	5.5	6.1	*90.2*	
271912				10.3	8.7	10.0	68	45							4.9	2.7	*55.1*	5.4	6.3	*85.7*	3.6
271811	[2] 12.4		*51.6*	8.6	7.6	8.9	71	49	3.4	3.4	3.6	3.5	*94.4*	*97.1*	4.9	2.6	*53.1*	4.6	6.1	*75.4*	
271816				8.7	7.8	9.4	75	55	3.5	3.65	3.8	3.7	*92.1*	*98.7*	4.8	2.6	*54.2*	4.6	6.0	*76.7*	3.0
271804	13.5	*80.7*	*49.6*	9.9	8.6	9.8	70	49	3.65	3.65	3.65	3.65	*100.0*	*100.0*	4.7	2.45	*52.1*	5.6	6.3	*88.9*	3.2
271910						9.5															
271813	13.1	*93.1*	*58.8*	9.6	8.5	9.4	65	55	3.5	3.6	4.0	4.1	*87.5*	*87.8*	5.5	2.6	*47.3*	5.3	6.4	*82.8*	3.1
271802	[2] 13.2	*78.8*	*49.2*	9.6	8.8	10.0	74	59		3.3		3.65		*90.4*	4.8	2.6	*54.2*	5.2	6.1	*85.3*	2.7
271812	12.8	*78.1*	*50.0*	9.5	8.6	9.8	73	53	3.4	3.6	3.7	3.7	*91.9*	*97.3*	4.9	2.4	*49.0*	5.0	6.0	*83.3*	2.7
271906	13.4	*90.3*	*56.0*	9.1	7.8	9.2	67	54	3.3	3.5	4.0	3.9	*82.5*	*89.7*	4.9	2.55	*52.0*	5.2	6.1	*85.3*	3.6
271858																					2.95
271809	13.3	*79.7*	*49.6*						3.35	3.45	3.7	3.6	*90.5*	*95.8*	4.85	2.65	*54.6*	5.3	6.3	*84.1*	3.05
271902	(13.5)	(*84.4*)	(*52.6*)	9.2	8.0	9.6	71	54	3.45	3.4	3.8	3.6	*90.8*	*94.4*	4.9	2.6	*53.1*	5.2	6.3	*82.5*	3.45
271801	12.7	*86.6*	*53.5*	9.6	8.0	9.3	67	43	3.3	3.2	3.6	3.5	*91.7*	*91.4*	4.75	2.3	*48.4*				3.5
271893	12.7	*89.0*	*57.5*	9.3	8.3	9.8	71	58	3.65	3.6	3.55	3.5	*102.8*	*102.9*	5.1	2.35	*46.1*	5.0	5.9	*84.8*	3.2
271900				9.6	8.3	9.6	68	53	3.3	3.2	3.5	3.5	*94.3*	*91.4*	4.75	2.25	*47.4*	5.6	6.0	*93.3*	
271810	13.1		*51.9*	9.4	7.6	8.9	65	38	3.4		3.6		*94.4*		4.7	2.55	*54.3*				3.5
271919	[2] 12.0	*95.8*	*58.3*						3.3	3.25	3.5	3.45	*94.3*	*94.2*	4.75	2.5	*52.6*	5.5	6.4	*85.9*	3.25
271903	12.6	*88.1*	*54.8*	9.7	8.2	9.1	64	46	3.3		3.75		*88.0*		[2] 4.7	2.45	*52.1*	5.5	6.2	*88.7*	3.35
269249				(9.6)		(9.1)															
269207	13.4	*80.6*	*46.3*	9.1	8.0	9.2	71	53	3.35	3.3	3.8	3.8	*88.2*	*86.8*	4.3	2.7	*62.8*	5.2	6.3	*82.5*	3.35
269303	13.7	*86.1*	*51.8*	(9.7)	(8.5)	(9.8)	(70)	(55)	3.2	3.3	3.7	3.7	*86.5*	*89.2*	4.8	2.4	*50.0*	5.3	6.4	*82.8*	3.6
228227	[2] (13.4)		(*51.5*)						3.55		3.8		*93.4*		4.85	2.65	*54.6*	5.2	6.4	*81.3*	
228230	[2] 12.8		*53.1*	9.3	7.8	9.4	70	46	3.5	3.6	3.5	3.4	*100.0*	*105.9*	4.75	2.55	*53.7*	5.5	6.2	*88.7*	
228229	[2] 12.8	*85.2*	*52.3*	9.3	8.0	9.2	68	51	3.3	3.2	3.55	3.65	*93.0*	*87.7*	4.5	2.45	*54.4*	5.3	6.0	*88.3*	3.3
228907				(8.6)	8.2	9.5	(81)	(68)		3.3		3.55		*93.0*	4.4	2.4	*54.5*				
228927	[2] (13.0)		(*53.9*)	9.7	8.0	9.2	65	43	3.3	3.3	3.5	3.4	*94.3*	*97.1*	4.75	2.5	*52.6*	5.3	5.9	*89.8*	
228226					8.2	9.6			3.5	3.45	3.8	3.7	*92.1*	*93.2*	4.75	2.4	*50.5*				
228276	[2] 11.8	*92.4*	*56.8*	9.0	7.9	9.2	70	54	3.25	3.2	3.45	3.35	*94.2*	*95.6*	4.6	2.05	*44.6*	5.0	5.6	*89.8*	3.0

[1] Near.

PUEBLOS—Continued

DEFORMED NEW MEXICO CRANIA.—FEMALE—Continued

OTHER TEWA AND MISCELLANEOUS—Continued

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Aveolar Arch, length, maxim.	Upper Alveolar Arch, breadth maxim	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
327067				9.6	8.5	9.9	71°	55°	3.2	3.35	3.7	3.6	*86.5*	*93.1*	4.9	2.5	*51.0*	5.2	5.8	*89.7*	3.7
327116	13.0		*49.2*	9.4	8.6	10.0	76	61	(3.6)	(3.7)	(3.9)	(3.7)	*(92.3)*	*(100.0)*	4.6	2.5	*54.4*				
327125	12.7				(7.7)	(9.1)			3.5	3.4	3.8	3.6	*92.1*	*94.4*	4.9	2.6	*53.1*				
327070				(8.7)	(7.5)	(9.1)	(71)	(52)	3.5	3.65	3.8	3.8	*92.1*	*96.1*	4.7	2.5	*53.2*	4.8			3.3
331212						9.4			3.3		3.7		*89.2*								
327140									3.45	3.6	3.9	3.85	*88.5*	*93.5*	5.2	2.3	*44.2*	5.1	6.9	*73.9*	
324684	12.7	*85.0*	*52.8*	9.0	8.1	9.6	74	56	3.5	3.5	3.8	3.7	*92.1*	*94.6*	4.9	2.4	*49.0*	4.9	6.0	*81.7*	3.1
243501	13.8		*50.7*	9.8	8.6	9.9	70	51	3.4	3.35	3.9	3.9	*87.2*	*85.9*	5.05	2.55	*50.5*	5.2	6.3	*82.5*	
314272	13.0	*76.2*	*48.5*	8.9	7.7	9.2	72	50	3.4	3.4	3.7	3.7	*91.9*	*91.9*	4.4	2.4	*54.6*	5.2	6.2	*83.9*	2.85
314271	(13.4)				7.6	9.0			3.4	3.45	3.9	3.8	*87.2*	*90.8*	4.55	2.5	*55.0*				
227411	13.0	*88.5*	*55.4*	9.6	8.4	9.2	65	54	3.35	3.2	3.5	3.5	*95.7*	*91.4*	4.9	2.5	*51.0*	5.2	6.3	*82.5*	3.4
339697	12.8	*85.9*	*58.9*	9.6	8.3	9.8	71	50	3.4	3.45	3.7	3.7	*91.9*	*93.2*	4.85	2.6	*53.6*	5.2	6.7	*77.6*	3.0
286301	11.7	*93.2*	*53.0*	8.5	7.5	9.2	76	54	3.3	3.25	3.4	3.4	*97.1*	*95.6*	4.4	2.1	*47.7*				3.2
317193	12.5	*83.2*	*52.8*	9.3	8.1	9.4	70	49	3.45	3.45	3.8	3.7	*90.8*	*93.2*	4.75	2.35	*49.5*	5.2	5.9	*88.1*	2.9
317195	(13.4)	*(82.8)*	*(53.0)*	(9.2)	(8.0)	(10.0)	(74)	(55)	3.5	3.5	3.9	3.8	*89.7*	*92.1*	4.7	2.2	*46.8*	5.0	6.0	*83.3*	3.3
Number of skulls	(30)	*(23)*	*(29)*	(32)	(35)	(37)	(32)	(31)	(42)	(37)	(42)	(37)	*(42)*	(57)	(44)	(44)	*(42)*	(36)	(35)	*(35)*	(31)
Totals	385.6			300.9	286.3	351.0			172.4	125.55	155.15	131.7			210.15	103.65		187.4	216.4		100.15
Averages	*12.85*	*85.89*	*52.61*	*9.40*	*8.18*	*9.49*	*70*	*51*	*3.39*	*3.40*	*3.69*	*3.64*	*91.78*	*93.43*	*4.78*	*2.47*	*51.70*	*5.21*	*6.18*	*84.3*	*3.23*
Minima	11.7	*76.2*	*46.3*	8.5	7.5	8.9	64	38	3.1	3.05	3.4	3.35	*82.5*	*85.9*	4.3	2.05	*44.2*	4.6	5.6	*73.9*	2.7
Maxima	13.8	*95.8*	*58.8*	10.3	8.8	10.0	76	61	3.65	3.65	4.0	4.1	*102.8*	*105.9*	5.5	2.9	*62.8*	5.6	6.9	*93.3*	3.7

308607									3.35	3.3	3.7	*3.6*	*90.5*	*91.7*	4.5	2.5	*55.6*		6.6		3.3
314318	13.4	*88.1*	*56.7*	10.0	8.7	10.0	68	52	3.4	3.5	4.0	3.9	*85.0*	*89.7*	5.3	2.5	*47.2*	5.7	6.1	*93.4*	3.6
326193						9.1									4.8	2.3	*47.9*				3.2
308633	12.4	*87.9*	*50.8*	9.1	8.0	9.0	68	49	3.3	3.4	3.6	3.6	*91.7*	*94.4*	4.6	2.5	*54.3*	4.9	6 2	*79.0*	3.2
308644	12.5	*82.4*	*52.0*	9 0	7.9	8.9	68	48	3.35	3.25	3.4	3.5	*98.5*	*92.9*	4.8	2.5	*52.1*	4.9	5.6	*87.5*	2.8
332499				10.3	9.0	10.4	71	49	3.2	3.2	4.0	3.95	*89.0*	*81.0*	4.95	2.7	*54.6*	5.6	6.7	*83.6*	3.1
308622	12.3	*83.7*	*52.0*	9.4	8.3	9.4	70	51	3.4	3.4	3.6	3.6	*94.4*	*94.4*	4.7	2.5	*53.2*	5.0			3.0
311284	12.0	*99.0*	*57.5*	9.8	8.6	9.3	65	52	3.5	3.4	3.8	3.5	*92.1*	*87.1*	4.7	2.2	*46.8*	5.0	5.6	*89.3*	3.3
308649						9.4				3.2		3.8		*84.2*							3.9
314309				8.6	7.9	9.2	74	55	3.5	3.6		3.7		*87.3*	4.9	2.5	*51.0*	4.7	6.1	*77.1*	2.8
308611	12.0	*86.7*	*49.2*	8.8	7.8	8.4	67	50	3.35	3.45	3.8	3.65	*88.2*	*84.5*	4.3	2.4	*55.8*	4.5	6.1	*73.3*	2.9
308741	13.2	*90.2*	*(50.0)*	9.3	8.4	9.5	71	53	3.3	3.3	3.9	3.7	*84.6*	*89.2*	4.5	2.5	*55.6*	5.1	6.1	*83.6*	3.6
308618	13.1	*86.3*	*50.4*	9.0	7.7	8.9	68	46	3.4	3.5	3.75	3.8	*90.7*	*92.1*	4.7	2.6	*55.3*	5 1	6.7	*76.1*	3.5
308679	(13.3)	*(79.7)*	*(48.1)*						3.5	3.6	3.9	3.8	*89.7*	*94.7*	4.6	2.6	*56.5*	5.2	6.3	*82.5*	3.4
308723						9.0				3.4		3.7		*91.9*							
308635				8.0	7.1	8.9	71											4.9	6.1	*80.3*	3.1
308642									3.0	3.2	3.8	3.6	*79.9*	*88.9*	4.6	2.6	*56.5*	5.6	6.4	*87.5*	3.5
314282									3.5	3.5	3.9	4.6	*89.7*	*87.5*	4.9	2.7	*55.1*	5.2	6.6	*78.8*	3.5
Number of skulls	(8)	(8)	(7)	(11)	(11)	(14)	(11)	(10)	(14)	(16)	(13)	(16)	(13)	(16)	(15)	(15)	(15)	(14)	(14)	(13)	(17)
Totals	100.9			101.3	89.4	129.4			47.05	54.2	49.15	59.4			70.85	37.6		71.4	87.2		55.7
Averages	*12.61*	*86.92*	*52.68*	*9.21*	*8.13*	*9.24*	*69*	*51*	*3.56*	*3.39*	*3.78*	*3.71*	*88.61*	*91.35*	*4.72*	*2.51*	*53.07*	*5.10*	*6.25*	*82.38*	*3.28*
Minima	12.0	*82.4*	*49.2*	8.0	7.1	8.4	65	46	3.0	3.2	3.4	3.5	*79.0*	*81.0*	4.3	2.2	*46.8*	4.5	5.6	*73.3*	2.8
Maxima	13.4	*90.2*	*57.5*	10.3	9.0	10.4	74	55	3.5	3.6	4.0	4.0	*98.5*	*97.3*	5.3	2.7	*56.5*	5.7	6.7	*93.4*	3.9

[2] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—FEMALE—Continued

SALT RIVER

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Modulo	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
239509	Hemenway	Salt River	Adult	Moderate lateral	(16.7)	(13.0)	(13.7)	(77.8)	(82.3)	(105.4)	14.47	1,215			
239294	do	do	do	Pronounced	(16.5)	(13.0)		(78.8)				(1,120)			6.7
239557	do	do	do	Medium lateral	(16.3)	(13.2)	(13.6)	(81.0)	(92.2)	(103.0)	14.37	1,175			6.8
239438	do	do	do	Slight	(16.4)	(13.4)	(13.2)	(81.7)	(88.6)	(98.5)	14.33	1,065			7.0
239209	do	do	do	Slight lateral	(17.0)	(14.0)		(82.4)				1,175			6.7
239712	do	do	do	Moderate	(16.2)	(13.5)	(13.6)	(83.3)	(91.6)	(109.7)	14.43	(1,120)			
239513	do	do	do	Pronounced	(15.8)	(13.2)	(14.5)	(83.5)	(109.0)	(159.8)	14.50	1,205			7.0
239534	do	do	do	do	(16.8)	(14.1)	(13.8)	(83.9)	(89.3)	(97.9)	14.90				[2] 6.8
239688	do	do	do	Moderate lateral	(16.6)	(13.5)	(13.8)	(84.4)	(93.6)	(102.2)	14.83	[2] 1,140	Considerable	11.6	7.1
239351	do	do	do	Pronounced	(16.3)	(13.8)		(84.7)				[2] 1,215			
239514	do	do	do	do	(16.4)	(13.9)	(14.8)	(84.8)	(97.7)	(106.5)	15.63	1,375			6.9
239474	do	do	do	do	(16.0)	(13.6)	(13.6)	(85.0)	(91.5)	(100.0)	14.50	1,200	Considerable	11.3	7.0
239606	do	do	do	Moderate	(16.0)	(13.6)	(13.4)	(85.0)	(90.5)	(98.5)	14.33	1,210	do	11.6	[2] 6.7
239686	do	do	do	Moderate lateral	(16.2)	(13.8)	(13.8)	(85.2)	(92.0)	(100.0)	14.60				
239377	do	do	do	Pronounced	(16.5)	(14.1)	(14.5)	(85.5)	(94.8)	(102.8)	15.03	1,340	Considerable	12.0	[2] 7.0
239646	do	do	do	do	(16.6)	(14.3)		(86.1)							
239622	do	do	do	do	(15.3)	(13.2)	(13.5)	(86.3)	(94.7)	(102.3)	14.09	1,110			
239528	do	do	do	Moderate	(16.2)	(14.0)	(13.6)	(86.4)	(99.1)	(97.1)	14.60	1,255			6.7
239469	do	do	do	Medium lateral	(16.4)	(14.2)	(13.2)	(86.6)	(85.5)	(93.0)	14.60	1,195			7.0
239596	do	do	do	Pronounced	(16.0)	(13.9)		(86.9)							6.9
239631	do	do	do	do	(16.6)	[2] (14.5)	(13.8)	(87.4)	(88.7)	(95.2)	14.97				[2] 6.9
239699	do	do	do	do	(16.8)	(14.8)	(13.8)	(88.1)	(82.3)	(93.2)	15.13	1,395			7.1
239270	do	do	do	do	(15.2)	(13.4)	(13.9)	(88.2)	(97.2)	(103.7)	14.17	1,210			[2] 6.7
239252	do	do	do	do	(16.2)	(14.3)	(13.9)	(88.3)	(92.1)	(97.2)	14.80	1,200			
239202	do	do	do	do	(16.5)	(14.6)	(13.9)	(88.5)	(89.4)	(95.2)	15.60	1,465	Considerable	11.1	7.1
239695	do	do	do	Moderate lateral	(15.1)	(13.4)	(14.5)	(88.7)	(101.8)	(108.2)	14.33	[2] 1,070			
239504	do	do	do	Pronounced	(15.2)	(13.5)	(13.3)	(88.8)	(92.7)	(98.5)	14.60	1,135			6.9
239781	do	do	do	do	(15.6)	(13.9)	(13.6)	(89.1)	(92.2)	(97.8)	14.37	1,215			7.0
239615	do	do	do	Medium lateral	(16.2)	(14.5)	(14.2)	(89.5)	(92.5)	(97.9)	14.97	[2] 1,250			
239465	do	do	do	Pronounced	(16.3)	(14.6)	(14.0)	(89.6)	(90.6)	(95.9)	14.97	1,255			[2] 7.5
239518	do	do	do	do	(16.0)	(14.4)	(13.9)	(90.0)	(91.5)	(96.5)	14.77	1,330			7.1
239690	do	do	do	do	(16.4)	(14.8)		(90.2)							

239537	do	do	do	do	(15.8)	(14.3)	(14.8)	(90.5)	(93.8)	(103.5)	14.97	1,335			6.8
239599	do	do	do	do	(15.0)	(13.6)	(13.2)	(90.7)	(92.3)	(97.1)	13.93	1,055			
239568	do	do	do	do	(15.3)	(13.9)	(14.0)	(90.8)	(95.9)	(100.7)	14.40	1,200			7.1
239496	do	do	do	do	(15.4)	(14.0)	(13.8)	(90.9)	(93.9)	(98.6)	14.40	1,190			7.2
239694	do	do	do	do	(16.4)	(15.0)	(13.6)	(91.5)	(86.6)	(90.7)	15.00				6.6
239713	do	do	do	do	(16.2)	(14.9)	(13.7)	(92.0)	(88.1)	(92.0)	14.93	[2] 1,275			6.6
239569	do	do	do	Moderate lateral	(16.2)	(14.9)		(92.0)				1,360			6.9
239623	do	do	do	Medium lateral	(15.4)	(14.2)	(12.9)	(92.2)	(87.2)	(90.9)	14.17				[2] 6.2
239413	do	do	do	Pronounced	(15.8)	(14.6)	(13.6)	(92.4)	(89.5)	(93.2)	14.67	1,210			
239536	do	do	do	do	[2](16.0)	(14.9)		(93.1)				[2] 1,260			7.3
239203	do	do	do	Moderate lateral	(15.1)	(14.1)	(14.6)	(93.4)	(109.0)	(103.6)	14.60	1,220	Considerable	11.7	7.5
239204	do	do	do	Pronounced	(15.3)	(14.3)	(13.9)	(93.5)	(93.9)	(97.2)	14.50	1,265	do	11.8	7.5
239577	do	do	do	do	(15.4)	[2](14.4)	[2](13.5)	(93.5)	(90.6)	(93.8)	14.43	1,200			6.85
239512	do	do	do	do	(15.7)	(14.7)	(14.1)	(93.6)	(92.8)	(95.9)	14.83	[2] 1,350			[2] 7.2
239215	do	do	do	do	(14.9)	(14.0)	(13.6)	(94.0)	(94.1)	(97.1)	14.17	1,170			
239211	do	do	do	do	(16.0)	(15.1)		(94.4)							
239293	do	do	do	do	(14.8)	(14.0)	(13.8)	(94.6)	(95.8)	(98.6)	14.20	1,260	Considerable	10.6	[2] 6.7
239563	do	do	do	do	(15.6)	(14.9)		(95.5)				[2] 1,280			6.9
239295	do	do	do	do	(14.8)	(14.2)	(13.3)	(96.0)	(91.7)	(93.7)	14.10	1,145	Considerable	11.0	6.8
239299	do	do	do	do	(14.8)	(14.3)		(96.6)				[2] 1,200	do	10.5	6.4
239616	do	do	do	do	(15.0)	(14.7)	(12.3)	(98.0)	(82.8)	(83.7)	14.60				
239545	do	do	do	do	(15.0)	(15.2)	(14.8)	(101.3)	(98.0)	(97.4)	15.00	[2] 1,400		12.4	7.6
239530	do	do	do	do		(12.4)	[2](13.0)			(104.8)				11.6	7.1
239659	do	do	do	do									Considerable	11.1	[2] 6.3
239633	do	do	do	do											
239258	do	do	do	do											6.6
239512	do	do	do	do			(14.0)						Considerable	11.4	7.2
239610	do	do	do	do	(15.7)										[2] 6.7
239546	do	do	do	do		(14.3)									7.0
239621	do	do	do	Moderate		(13.4)	(12.8)			(95.5)					7.0
Number of skulls											(43)	(42)		(14)	(46)
Totals											625.80	51,715		159.7	318.65
Averages											*14.55*	*1,231*		*11.41*	*6.93*
Minima											13.93	1,055		10.5	6.2
Maxima											15.13	1,465		12.4	7.6

OLD HOPI

156324	J. W. Fewkes	Awatobi	25	Slight	(17.2)	(14.2)	(12.8)	(82.6)	(81.5)	(90.1)	14.73	[2] 1,310			6.6
177932	do	do	50	Moderate	(15.8)	(14.0)		(88.6)				1,115			
156321	do	Sikyatki	35	Slight	(16.6)	(14.4)	[2](13.6)	(86.8)	(87.7)	(94.4)	14.87	[2] 1,310			7.2
Number of skulls											(2)	(3)			(2)
Totals											29.60	3,735			13.8
Averages											*14.80*	*1,245*			*6.9*
Minima											14.73	1,115			6.6
Maxima											14.87	1,310			7.2

[2] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—FEMALE—Continued

ELDEN

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Modulo	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
336620	J. W. Fewkes	Elden	35	Slight	(16.2)	(13.4)	------	(82.7)	------	------	------	(1,230)	No wear	------	6.9
336619	do	do	35	Moderate	(15.6)	(13.4)	(13.4)	(85.9)	(92.4)	(100.0)	14.13	1,250	do	10.7	6.6
339719	do	do	25	Pronounced	(16.2)	(14.8)	(14.2)	(91.4)	(91.6)	(96.0)	15.07	1,350	do	11.5	7.0
339726	do	do	25	Pronounced lateral	(15.6)	(14.4)	(13.6)	(92.3)	(92.0)	(95.8)	14.60	------	do	10.8	6.5
339720	do	do	23	Moderate	(15.1)	(14.5)	------	(96.0)	------	------	------	[2] 1,350	do	11.8	7.1
339728	do	do	40	------	------	------	------	------	------	------	------	------	do	12.8	7.9
Number of skulls					------	------	------	------	------	------	(5)	(3)	------	(5)	(6)
Totals					------	------	------	------	------	------	43.80	3,950	------	57.6	42.0
Averages					------	------	------	------	------	------	*14.60*	*1,317*	------	*11.52*	*7.00*
Minima					------	------	------	------	------	------	14.13	1,230	------	10.7	6.5
Maxima					------	------	------	------	------	------	15.07	1,350	------	12.8	7.9

CHAVES PASS

158046	J. W. Fewkes	Chaves Pass	30	Slight	(16.6)	(13.4)	(14.2)	(80.7)	(94.7)	(103.0)	14.73	1,370	------	------	7.0
158118	do	do	55	Moderate	(16.2)	(13.7)	(12.9)	(84.6)	(86.3)	(94.2)	14.27	1,300	Irregular	------	6.3
157682	do	do	35	Medium	(15.8)	(13.4)	(13.1)	(84.8)	(89.7)	(97.8)	14.10	1,145	------	------	6.7
157666	do	do	40	Moderate	(16.2)	(13.8)	(13.4)	(85.2)	(89.3)	(97.1)	14.47	1,150	------	------	6.8
157689	do	do	50	do	(16.2)	(14.0)	(14.5)	(86.4)	(96.0)	(103.6)	14.90	1,350	Medium	------	7.2
157687	do	do	60	do	(16.0)	(13.9)	(13.3)	(86.9)	(89.0)	(95.7)	14.40	1,255	------	------	------
158113	do	do	55	Medium	(15.9)	(13.9)	(14.2)	(87.4)	(95.3)	(102.2)	14.67	1,300	------	------	7.0
158047	do	do	70	Medium lateral	(15.4)	(13.5)	(12.7)	(87.7)	(87.9)	(94.1)	13.87	1,155	------	------	------
157699	do	do	55	Medium	(15.5)	(13.6)	(13.8)	(87.7)	(94.9)	(101.5)	14.30	1,130	------	------	------
157676	do	do	25	do	(16.0)	(14.3)	(13.4)	(89.4)	(88.5)	(93.7)	14.57	(1,290)	------	------	6.8
158108	do	do	40	do	(15.5)	(13.9)	(13.8)	(89.7)	(93.9)	(99.3)	14.40	1,270	------	------	6.7
157672	do	do	40	Pronounced	(15.6)	(14.0)	(13.6)	(89.7)	(91.9)	(97.1)	14.40	1,290	------	------	7.2
157684	do	do	30	Moderate	(14.8)	(13.6)	(12.6)	(91.9)	(88.7)	(92.7)	13.67	1,065	No wear	------	7.1
158111	do	do	35	Medium	(15.1)	(14.0)	------	(92.7)	------	------	------	[2] 1,210	------	------	7.3

157669	do	do	25	Pronounced	(15.6)	(14.6)	(12.8)	(93.6)	(84.8)	(87.7)	14.33	[2] 1,310			7.4
157673	do	do	30	Considerable	(15.2)	(14.6)	(13.2)	(96.1)	(88.6)	(90.4)	14.33	1,220			6.8
158045	do	do	40	do		(13.8)	(13.1)			(94.9)					6.9
Number of skulls											(15)	(15)			(14)
Totals											215.41	18,550			97.2
Averages											*14.36*	*1,237*			*6.94*
Minima											13.87	1,065			6.3
Maxima											14.90	1,370			7.4

PETRIFIED FOREST

213346	W. Hough	Petrified forest	50	Slight	(16.8)	(14.4)	(13.0)	(85.7)	(83.3)	(90.3)	14.73	[2] 1,400	Medium	11.1	6.8
213323	do	do	45	Considerable lateral	(16.1)	(14.1)	(13.6)	(87.6)	(90.1)	(96.5)	14.60	1,210			
213330	do	do	35	Medium	(15.7)	(14.2)	(13.6)	(90.5)	(91.0)	(95.8)	14.50	1,290	Moderate	11.7	7.1
213352	do	do	25	do	(15.3)	(14.4)	(13.6)	(94.1)	(91.6)	(94.4)	14.43	1,300	No wear	10.8	6.7
213331	do	do	40	Considerable	(15.0)	(14.2)	(13.3)	(94.7)	(91.1)	(93.7)	14.17	1,170	Moderate	11.1	7.0
213338	do	do	30	do	(15.3)	(14.6)	(13.9)	(95.4)	(92.0)	(95.2)	14.66		Slight	11.3	6.7
Number of skulls											(6)	(5)		(5)	(5)
Totals											87.03	6,370		56.0	34.3
Averages											*14.51*	*1,274*		*11.20*	*6.86*
Minima											14.17	1,170		10.8	6.7
Maxima											14.73	1,400		11.7	7.1

MISCELLANEOUS

177878	J. W. Fewkes	Four-Mile Canyon	35	Slight	(16.2)	(13.7)	(13.9)	(84.6)	(93.0)	(101.5)	14.60	1,340	Slight	11.4	6.6
177877	do	do	45	do	(16.1)	(13.9)		(86.5)				(1,180)			
177882	do	do	25	Medium lateral	(15.7)	(13.7)	(13.8)	(87.3)	(93.9)	(100.7)	14.46	[2] 1,259	No wear	11.1	6.9
177879	do	do	25	Considerable	(15.6)	(14.1)	(13.9)	(90.4)	(93.6)	(98.6)	14.53		do	11.7	6.8
177876	do	do	40	Medium	(15.0)	(13.8)	(13.6)	(92.0)	(94.4)	(98.6)	14.17	1,195			6.8
177871	do	do	40	Considerable	(14.8)	(14.6)	(14.3)	(98.7)	(97.2)	(98.9)	14.57	1,280			7.0
176944	do	Kintiel	30	Pronounced lateral	(16.0)	(13.8)	(13.6)	(83.3)	(91.8)	(98.6)	14.47	1,625			
176946	do	do	60	Moderate	(16.30)	(14.5)	(14.4)	(92.6)	(94.4)	(99.3)	14.97	1,310			7.2
176940	do	do	35	Medium	(15.3)	(14.1)	(14.2)	(92.2)	(93.6)	(100.7)	14.53	1,180	No wear	11.6	7.0
176943	do	do	55	Pronounced	(15.0)	(14.4)	(13.8)	(96.6)	(93.9)	(95.8)	14.46	1,145			7.0
176951	do	do	55	Considerable	(15.5)	(15.0)	(13.2)	(96.8)	(86.6)	(98.0)	14.57	[2] 1,350			
176948	do	do	24	do	(14.6)	(14.6)	(14.3)	(100.0)	(98.0)	(98.0)	14.50		No wear	11.4	7.0
213287	W. Hough	McDonald Canyon	30	Slight	(17.2)	(14.0)	(14.2)	(81.4)	(91.0)	(101.4)	15.10	1,470			7.6
213290	do	do	35	Medium	(16.9)	(15.0)	(14.0)	(83.8)	(87.8)	(93.5)	15.30	1,475			6.9
213284	do	do	25	do	(15.5)	(13.8)	(12.5)	(89.0)	(85.5)	(90.6)	13.93	1,170			6.7
213289	do	do	35	do	(15.1)	(13.6)	(13.7)	(90.1)	(87.5)	(100.7)	14.13	1,150			7.0
213293	do	do	25	Considerable	(15.4)	(14.0)	(14.0)	(90.9)	(95.2)	(100.0)	14.47	1,270			7.3

[2] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—FEMALE—Continued

MISCELLANEOUS—Continued

Catalogue No.	Collection	Location	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
246971	W. Hough	Graham Co	60	Considerable	(16.2)	(14.1)	(13.6)	(87.0)	(89.8)	(96.5)	14.63	1,230	Slight	12.2	7.9
246992	do	do	30	do	(16.2)	(14.6)		(90.1)					No wear	12.1	7.1
246997	do	do	25	do	(15.4)	(14.8)	[2] (14.0)	(96.1)	(92.7)	(94.6)	14.73	[2] 1,240	do	11.8	7.0
246998	do	do	25	do		(14.4)	(13.0)			(90.3)			do	11.1	6.8
246994	do	do	35	do									do	11.6	7.1
270461	J. W. Fewkes	Black Falls	60	do	(15.4)	(13.4)	(13.2)	(87.0)	(91.7)	(98.5)	14.00	1,175			
270464	do	do	40	do	(15.6)	(14.0)	(13.4)	(89.7)	(90.5)	(95.7)	14.33	1,200		[2] 12.7	7.9
270466	do	do	25	do	(14.9)	(13.7)	[2] (13.5)	(92.6)	(94.4)	(98.5)	14.03	1,200	No wear	11.6	6.9
270467	do	do	25	do	(15.3)	(14.2)		(92.8)					do	11.1	6.6
243906	G. M. Brayton	Camp Verde	45	Medium	(16.4)	(14.0)	(13.8)	(85.4)	(90.8)	(98.6)	14.73	1,375	Slight	11.8	7.3
243902	do	do	25	do	(15.6)	(13.7)	(13.9)	(87.8)	(94.9)	(101.5)	14.40				7.0
254905	C. H. Campbell	do	50	do	(15.3)	(13.8)	(13.1)	(90.2)	(90.0)	(94.9)	14.07	1,235			6.9
157453	J. W. Fewkes	Chevlon	50	Moderate	(16.1)	(14.0)	[2] (12.9)	(87.0)	(85.7)	(92.1)	14.33	1,130			
157290	do	do	35	do	(15.6)	(14.0)	(13.2)	(89.7)	(89.2)	(94.3)	14.27	1,240			7.0
329776	M. N. Perkins	Perkinsville	25	Medium	(16.8)	(14.1)	(12.3)	(83.9)	(79.6)	(87.2)	14.40	1,180	No wear	11.2	[2] 6.9
254563	J. W. Fewkes	Casa Grande	Young Adult	Slight	(16.1)	(13.6)	[2] (13.6)	(84.5)	(91.6)	(100.0)	14.43				
229363	F. M. Palmer	Canyon del Muerte	30	Moderate	(15.9)	(13.8)	(13.3)	(87.8)	(89.6)	(96.4)	14.33	1,295	No wear	11.6	7.0
317700	H. A. Hughes	Near Phoenix	50	Medium	(15.5)	(13.7)	(13.8)	(88.4)	(94.5)	(100.7)	14.33	[2] 1,180			6.7
243938	H. C. Hodge	Chind Valley	55	Considerable	(15.6)	(14.2)	(13.5)	(91.0)	(90.6)	(95.1)	14.43	1,165			
213325	W. Hough	Showlow	30	Medium	(15.3)	(14.6)	(14.0)	(95.5)	(95.6)	(100.0)	14.43	1,320	No wear	11.2	6.8
213324	do	Linden	45	do	(16.2)	(14.9)	(14.4)	(92.0)	(92.6)	(96.6)	15.17	1,340	Slight	11.5	7.0
243935	J. C. McKee	Prescott	50	Considerable	(15.2)	(14.0)	(13.6)	(92.1)	(93.2)	(97.1)	14.27	1,120			
239201	Hemenway	Pescado Valley	Adult	Moderate lateral	(14.9)	(14.4)	(13.8)	(96.6)	(94.2)	(95.8)	14.37	1,320	Considerable	10.6	

Number of skulls																				(35)	(31)				(19)	(31)				
Totals																				506.31	38,835				219.3	217.7				
Averages																				*14.47*	*1,253*				*11.54*	*7.02*				
Minima																				13.93	1,120				10.6	6.6				
Maxima																				15.30	1,475				12.7	7.9				

SALT RIVER

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
						°	°														
239509	13.1			[2] (8.8)		(9.9)			3.35	3.4	3.8	3.7	*88.2*	*91.9*	4.85	2.5	*51.6*				
239294	[2] 12.3		*54.5*						3.65	3.5	3.85	3.75	*94.8*	*93.8*	4.7	2.6	*55.3*	5.3	5.7	*93.0*	
239557	[2] 12.6		*54.0*	9.7		9.2	65		3.35	3.4	3.7	3.65	*90.5*	*93.2*	4.7	2.8	*59.6*	5.1	6.3	*81.0*	
239438	12.5		*56.0*	9.9		9.7	68		3.35	3.25	3.5	3.5	*95.7*	*92.9*	5.0	2.5	*50.0*	5.5	6.45	*85.3*	
239209	[2] 11.8		*56.8*						3.5	3.6	3.6	3.7	*97.2*	*97.3*	5.05	2.2	*43.6*	5.1	6.0	*85.0*	
239712						9.7			3.65	3.65	3.95	3.7	*92.4*	*98.7*	5.1	2.7	*52.9*				
239513	[2] 12.4		*56.5*	10.3		9.8	66		3.45	3.4	3.7	3.55	*93.2*	*95.8*	4.75	2.5	*52.6*	(5.7)	(5.7)	*(100.0)*	
239534				[2] (9.1)		(8.2)	(60)														
239688	12.1	*95.9*	*58.7*	[2] (9.7)		[2] (9.8)	(70)		3.6	3.6	3.7	3.7	*97.3*	*97.3*	1.9	2.5	*51.0*	5.4	6.5	*83.1*	
239351	12.2																				
239514	13.5		*51.1*	10.4		10.8	74		3.35	3.45	3.7	3.75	*90.5*	*92.0*	5.15	2.6	*50.5*	5.3	6.45	*82.2*	
239474	12.6	*89.7*	*55.6*	9.9		10.0	70		3.45	3.4	3.9	3.9	*88.5*	*87.2*	5.1	2.5	*49.0*	5.4	[2] 6.1	*88.5*	
239606	12.3	*94.3*	*54.5*	[2] (9.3)		(9.8)	(74)		3.7	3.55	3.7	3.8	*100.0*	*93.4*	4.85	2.3	*47.4*	5.1	6.0	*85.0*	
239686						10.3			3.45	3.5	3.9	3.8	*88.5*	*92.1*		2.4					
239377	12.9	*93.0*	*54.3*	9.8		10.2	73		3.2	3.3	3.7	3.6	*86.5*	*91.7*	4.85	2.4	*49.5*	5.3	[2] 5.9	*89.8*	
239646									3.55	4.05					5.0	2.6	*52.0*		6.1		
239622	12.6					(9.8)				3.6		3.75		*96.0*							
239528	12.5		*53.6*	9.7		9.7	70		3.25	3.2	3.6	3.55	*90.3*	*90.1*	4.65	2.5	*53.8*	5.5	5.95	*92.4*	
239469	13.8		*50.7*	9.3		9.4	69		3.2	3.3	3.8	3.6	*84.2*	*91.7*	5.1	2.65	*52.0*	5.2	6.3	*82.5*	
239596									3.25	3.2	3.55	3.55	*91.6*	*90.1*	[2] 4.8	2.7	*56.3*	5.4	6.2	*87.1*	
239631	[2] 13.3		*51.9*	[2] (9.9)		[2] (9.6)	(68)		3.6	3.7	[2] 3.8	3.85	*94.7*	*96.1*	[2] 4.3	2.55	*59.3*	5.3	6.4	*82.8*	
239699	13.5		*52.6*	9.8		10.2	72		3.45	3.65	3.85	3.9	*89.6*	*93.6*	5.1	2.3	*45.1*				
239279	[2] 12.4		*54.0*	(9.0)		(9.8)	(76)		3.55	3.45	3.8	3.8	*93.4*	*90.8*	4.8	[2] 2.6	*54.2*	4.6	[2] 5.8	*79.3*	
239252	13.4					10.0			3.2	3.2	3.9	4.0	*82.1*	*80.0*	4.6	2.5	*54.4*				
239202	13.2	*84.1*	*53.8*	9.8		9.9	70		3.4	3.35	3.65	3.75	*93.2*	*89.3*	5.0	2.45	*49.0*	5.3	6.05	*87.6*	
239695	12.3								3.5	3.6	3.5	3.55	*100.0*	*101.4*	4.6	2.35	*51.1*				
239594	[2] 13.0		*53.1*	9.9		9.6	67		3.25	3.3	3.7	3.6	*87.8*	*91.7*	4.75	2.35	*49.5*	5.3	6.1	*86.9*	
239381	13.0		*53.9*	9.6		9.8	70		3.35	3.4	3.9	3.8	*85.9*	*89.5*	4.75	2.4	*50.5*	5.2	[2] 5.9	*88.1*	

[1] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—Female—Continued

SALT RIVER—Continued

Catalogue No.	Diam. Bizygomatic maxim. (c)	Facial Index, total $\left(\frac{a \times 100}{c}\right)$	Facial Index, upper $\left(\frac{\times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	Orbital Index, right	Orbital Index, left	Nose, height	Nose, breadth maxim.	Nasal Index	Upper Alveolar Arch, length, maxim.	Upper Alveolar Arch, breadth maxim	Upper Alveolar Arch, Index	Lower Jaw, height at Symphysis
							°	°													
239615						(9.8)			3.45	3.4	3.95	3.95	87.3	86.1	4.85	2.4	49.5				
239465	13.1		57.3	10.2		10.0	67		3.45	3.3	3.85	3.8	89.6	86.8	5.05	2.6	51.5	5.6	6.4	87.5	
239518	12.8		55.7	(9.3)		(9.8)	(73)		3.3	3.4	3.7	3.7	89.2	91.9	5.7	2.45	42.9	5.3	5.75	92.2	
239630																					
239537	12.4		54.8	8.7		9.3	75		3.25	3.25	3.5	3.5	92.9	92.9	4.8	2.3	47.9	4.7	6.1	77.1	
239599	13.2					10.2			3.25	3.2	3.8	3.7	85.5	86.5	5.05	2.5	49.5				
239568	[2]12.8		55.5	(8.9)		(9.5)	(73)		3.4	3.55	3.75	3.65	90.7	97.3	5.0	2.6	52.0	[2]5.6	[2]6.2	90.3	
239496				9.5		9.6	69		3.5	3.45	3.7	3.7	94.6	93.2	5.0	2.7	54.0	5.1	6.3	81.0	
239604	13.0		56.8	10.0		10.2	73		3.4	2.35	[2]3.95	3.75	86.1	89.5	4.9	2.5	51.0	5.4	6.5	83.1	
239713				(9.5)		(9.6)	(71)		3.45	3.5	3.7	3.9	93.2	89.7	4.7	2.5	53.2	5.2	[2]6.3	82.5	
239569	13.0		53.1	8.2		9.6	68		3.35	3.4	3.8	3.85	88.2	88.3	4.7	2.55	54.3	5.4	5.95	90.8	
239623				[2]9.0		9.0	70		[2]3.35	3.2		3.85		80.1	4.75	2.75	57.9	4.9	6.3	77.8	
239413	13.0			9.7		9.6			3.3	3.5	3.75	3.7	88.0	94.6	4.8	2.5	52.1	[2]5.3	[2]5.9	89.8	
239536	13.4		54.5						3.6	3.65	3.85	3.85	96.3	94.8	4.95	2.9	58.6				
239203	12.9	90.7	58.1	10.2		10.0	67		3.45	3.4	3.9	3.9	88.5	87.2	5.1	2.6	51.0	5.1	6.4	79.7	
239204	13.2	89.4	56.8	10.0		9.7	66		3.5	3.5	3.7	3.6	94.6	97.2	5.1	2.25	44.1	5.5	6.3	87.3	
239577	[2]13.0		52.7	(9.2)		(9.5)	(71)		3.4	3.55	3.8	3.8	89.5	93.4	4.35	2.4	55.2	5.1	6.2	82.3	
239542	[2]12.8		56.3	9.3		9.8	72		3.45	3.45	3.65	3.6	94.5	95.8	4.95	2.4	48.5	5.0			
239215	12.5					(9.6)			3.35	3.3	3.7	3.8	90.5	86.8	4.9	2.35	48.0	[2]5.1	6.0	85.0	
239211																					
239293	12.5	84.8	54.6	9.0		9.7	75		3.4	3.4	3.8	3.75	89.5	90.7	4.65	2.5	53.8	4.6			
239563									3.1	3.15	3.65	3.8	85.2	79.8	5.15	2.8	54.4	[2]4.9			
239295	12.6	87.3	54.0	9.3		9.2	68		3.5	3.55	3.8	3.7	92.1	96.0	4.85	2.6	53.6	5.0	6.1	82.0	
239299	12.5	84.0	51.2						3.4	3.4	3.6	3.8	94.4	89.5	4.5	2.3	51.1	4.8	5.8	82.8	
239616						[2](9.4)															
239515				(9.3)		(10.0)	(72)			3.4		3.7		91.2	5.25						
239530	12.8	90.6	55.5	9.6		10.3	75		3.4	3.6	3.75		90.7		5.1	2.2	43.1	4.9	5.8	84.5	
239659	[2]12.3	90.2	51.2	8.9		9.5	76		3.4	3.45	3.6	3.7	94.4	93.2	4.65	2.5	53.8	[2]4.8	6.2	77.4	
239633	[2]13.0					9.9			3.7	3.7	3.75	3.7	98.7	100.0	5.0	2.45	49.0				
239258				(7.8)		(8.8)	(75)			3.4		3.8		89.5							
239512	13.2	86.4	54.6	10.3		10.2	69		3.45	3.55	3.7	3.7	93.2	96.0	5.0	2.65	53.0	5.6	6.1	91.8	
239610	12.6		53.2						3.4	3.4	[2]3.65	3.7	93.2	91.9	[2]4.75	2.35	49.5	5.5	6.2	88.7	

239516									3.15	3.25		3.7		87.8	4.9	2.5	51.0	5.3	[2]6.4	82.8		
239621	12.2		57.4	[2](9.1)		(9.2)	(69)		3.5	3.65	3.6	3.65	97.2	100.0	5.05	2.4	47.5	5.3	5.9	89.3		
Number of skulls	(46)	(15)	(37)	(27)		(32)	(26)		(54)	(57)	(51)	(55)	(51)	(55)	(54)	(54)	(53)	(42)	(40)	(39)		
Totals	588.1			261.7		314.1			184.5	196.55	190.7	204.8			263.95	134.95		218.3	245.3			
Averages	*12.78*	*89.22*	*54.35*	*9.69*		*9.82*	*70*		*3.42*	*3.45*	*3.74*	*3.72*	*91.48*	*92.24*	*4.89*	*2.50*	*51.24*	*5.20*	*6.13*	*85.20*		
Minima	11.8	84.0	50.7	8.7		9.0	65		3.15	3.2	3.5	3.50	82.1	89.0	4.3	2.2	48.0	4.6	5.7	77.1		
Maxima	13.8	95.9	58.7	10.4		10.8	76		3.7	4.05	3.95	4.0	100.0	101.4	5.7	2.9	59.6	5.6	6.5	93.0		

OLD HOPI

156324	12.2		54.1	9.3	8.0	9.2	69	49	3.4	3.45	3.6	3.55	94.4	97.2	4.6	2.4	52.2	5.2	6.3	82.5		3.3
177932	13.0								3.5	3.5	3.7	3.7	94.6	94.6	4.95	2.55	51.5					
156321	13.1		55.0			[2]10.0			3.7		3.6		102.8		5.1	[2]2.5	49.0					
Number of skulls	(3)		(2)			(2)			(3)	(2)	(3)	(2)	(3)	(2)	(3)	(3)	(3)					
Totals	38.3					19.2			10.6	6.95	10.9	7.25			14.65	7.45						
Averages	*12.77*		*54.75*			*9.60*			*3.53*	*3.48*	*3.63*	*3.63*	*97.25*	*95.85*	*4.88*	*2.48*	*50.85*					
Minima	12.2		*54.1*			9.2			3.4	3.45	3.6	3.55	94.4	94.6	4.6	2.4	49.0					
Maxima	13.1		55.0			10.0			3.7	3.5	3.7	3.7	102.8	97.2	5.1	2.55	52.2					

ELDEN

336620	13.4		51.5						3.45	3.5	3.8	3.9	90.8	89.7	4.9	2.4	49.0					3.6
336619	[2]12.3	87.0	52.7	9.5	8.2	9.2	68	47		3.4		3.5		97.1	4.75	2.3	48.4	4.9	6.0	81.7		3.1
339719	12.6	91.3	55.6	(8.8)	(8.0)	(9.5)	(73)	(61)	3.4	3.45	3.55	3.6	95.8	95.8	5.15	2.3	44.7	4.9	6.6	74.2		3.1
339725									3.3	3.3	3.7	3.6	89.2	91.7	4.65	2.6	55.9	5.3	5.9	89.3		2.9
339720										3.5		3.8		92.1	5.25	2.85	54.3	5.2	7.1	73.2		3.4
339728	12.4	103.2	62.7						3.65	3.8	3.7	3.7	98.7	102.7	5.6	2.5	44.6	5.1	6.2	82.3		3.4
Number of skulls	(4)	(3)	(4)	(1)	(1)	(1)	(1)	(1)	(4)	(6)	(4)	(6)	(4)	(6)	(6)	(6)	(6)	(5)	(5)	(5)		(6)
Totals	50.7			9.5	8.2	9.2	68	47	13.8	20.95	14.75	22.1			30.3	14.95		25.4	31.8			19.5
Averages	*12.68*	*93.83*	*56.02*						*3.45*	*3.49*	*3.69*	*3.68*	*93.56*	*94.80*	*5.05*	*2.49*	*49.54*	*5.08*	*6.36*	*79.87*		*3.25*
Minima	12.3	87.0	51.5						3.3	3.3	3.55	3.5	89.2	89.7	4.65	2.3	44.6	4.9	5.9	73.2		2.9
Maxima	13.4	103.2	63.7						3.65	3.8	3.8	3.9	98.7	102.7	5.6	2.85	55.9	5.3	7.1	89.8		3.6

CHAVES PASS

158046	12.1		57.9	10.2	8.8	10.0	69	50	3.4	3.3	3.7	3.7	91.9	89.2	4.8	2.45	51.0	5.6	6.6	84.9		
158118	12.0		52.5	9.0	7.9	9.0	70	46	3.2	3.25	3.6	3.6	88.9	90.3	4.75	2.55	53.7	4.8	[2]5.9	81.4		
157682	12.5		53.6	9.5	8.4	9.9	74	57	3.4	3.3	3.85	3.7	83.3	89.2	4.4	2.2	50.0	5.1	6.1	83.6		
157666	12.8		53.1	9.7	8.7	9.8	70	56	3.4	3.4	3.7	3.7	91.9	91.9	4.8	2.5	52.1	5.4	7.1	76.1		

[2] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—FEMALE—Continued

CHAVES PASS—Continued

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
							°	°													
157689	13.2		*54.6*	10.2	8.6	10.2	70	47	3.5	3.4	3.8	3.7	*92.1*	*91.9*	4.95	2.7	*54.6*	5.6	[2] 6.2	*90.3*	
157687						9.8															
158113	(13.2)		*(53.0)*	9.8	9.0	10.3	73	59	3.45	3.5	3.5	3.7	*90.8*	*94.6*	5.2	2.2	*42.3*				
158047						9.1			3.35	3.45	3.9	3.65	*85.9*	*94.5*	4.8	[2] 2.4	*50.0*				
157689						9.7															
157676	13.2		*51.5*	9.5	8.2	9.3	67	49	3.35	3.4	3.75	3.75	*89.3*	*90.7*	4.7	2.35	*50.0*	5.2	6.2	*83.9*	
158108	12.6		*53.2*	9.8	8.6	9.6	68	50	3.4	3.4	3.8	3.7	*89.5*	*91.9*	4.75	2.7	*56.8*	5.3	6.3	*84.1*	
157672	(13.1)		*(55.0)*	9.2	8.4	9.8	72	62	3.35	3.5	3.85	3.85	*87.0*	*90.9*	5.1	2.35	*46.1*				
157684	12.3		*57.7*	9.6	8.2	9.2	65	48	3.55	3.6	3.8	3.8	*93.4*	*94.7*	4.95	2.4	*48.5*	5.6	6.2	*90.3*	
158111	13.1		*55.7*						3.4	3.4	3.7	3.7	*91.9*	*91.9*	5.1	2.5	*49.0*	5.2	6.4	*81.3*	
157669	(13.6)		*(53.4)*			9.6			3.5	3.55	3.95	3.8	*88.6*	*93.4*	5.3	2.5	*47.2*	5.3	6.3	*84.1*	
157673	12.8		*53.1*	9.4	8.0	9.0	66	48	3.4		3.6		*94.4*		4.65	2.45	*52.7*				
158045	(13.2)		*(52.3)*	10.0	8.6	9.6	67	47	3.3	3.3	3.6	3.6	*91.7*	*91.7*	4.9	2.45	*50.0*	5.6	6.6	*84.9*	
Number of skulls	(10)		*(10)*	(12)	(12)	(16)	(12)	(12)	(15)	(14)	(15)	(14)	*(15)*	*(14)*	(15)	(15)	*(15)*	(11)	(11)	(11)	
Totals	126.6			115.9	101.4	153.9			50.95	47.75	56.4	51.95			73.15	36.7		58.7	69.9		
Averages	*13.66*		*54.32*	*9.66*	*8.45*	*9.62*	*69*	*52*	*3.40*	*3.41*	*3.76*	*3.71*	*90.34*	*91.91*	*4.88*	*2.45*	*50.30*	*5.34*	*6.85*	*83.98*	
Minima	12.0		*51.5*	9.0	7.9	9.0	65	46	3.2	3.25	3.6	3.6	*85.9*	*89.2*	4.4	2.2	*42.3*	4.8	5.9	*76.1*	
Maxima	13.2		*57.9*	10.2	9.0	10.3	74	62	3.55	3.6	3.95	3.85	*94.4*	*94.7*	5.3	2.7	*56.8*	5.6	7.1	*90.3*	

PETRIFIED FOREST

213346	13.3	*83.5*	*51.1*	9.4	8.2	9.5	70	51	3.35		3.7		*90.5*		4.9	2.4	*49.0*	5.2	6.1	*85.3*	3.4
213330	12.4	*94.4*	*57.3*	9.8	8.4	9.6	67	50	3.45	3.5	3.75	3.65	*92.1*	*95.9*	4.75	2.5	*52.6*	5.7	6.6	*86.4*	3.4
213352	12.8	*84.4*	*52.3*	9.5	8.0	9.4	69	46	3.45	3.45	3.7	3.7	*93.2*	*94.2*	4.6	2.7	*58.7*	5.1	6.2	*82.3*	3.3
213331	(13.2)	*(84.1)*	*(53.0)*	9.3	7.8	9.2	68	45	3.45	3.45	3.7	3.6	*93.2*	*95.8*	4.9	2.5	*51.0*	5.4	6.7	*80.6*	3.3
213338	(13.2)	*(85.6)*	*(50.8)*	(8.5)	(7.5)	(9.0)	(72)	(54)	3.3	3.25	3.8	3.8	*86.8*	*85.5*	4.9	2.45	*50.5*	5.1	6.3	*81.0*	2.8

Number of skulls	(3)	(3)	(3)	(4)	(4)	(4)	(4)	(4)	(5)	(4)	(5)	(4)	(5)	(4)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Totals	38.5			38.0	32.4	37.7			17.0	13.65	18.65	14.75			24.05	12.55		26.5	31.9		16.2
Averages	*12.83*	*87.27*	*53.51*	*9.59*	*8.10*	*9.43*	*69*	*48*	*3.40*	*3.41*	*3.73*	*3.69*	*91.15*	*92.51*	*4.81*	*2.51*	*52.18*	*5.30*	*6.38*	*83.07*	*3.24*
Minima	12.4	*83.5*	*51.1*	9.3	7.8	9.2	67	45	3.3	3.25	3.7	3.6	*86.8*	*85.5*	4.6	2.4	*49.0*	5.1	6.1	*80.6*	2.8
Maxima	13.3	*94.4*	*57.3*	9.8	8.4	9.6	70	51	3.45	3.5	3.8	3.8	*93.2*	*95.9*	4.9	2.7	*58.7*	5.7	6.7	*86.4*	3.4

MISCELLANEOUS

177878	13.0	*87.7*	*50.8*	9.3	8.2	9.6	72	51	3.3	3.25	3.5	3.6	*94.3*	*90.3*	4.85	2.5	*51.6*	5.0	6.2	*80.7*	3.3
177877									3.3		3.6		91.7								3.4
177882	(12.9)	*(86.1)*	*(53.5)*	9.5	8.2	9.8	72	51	3.5	3.4	3.65	3.6	*95.9*	*94.4*	4.75	2.2	*46.3*	5.0	6.2	*80.7*	3.1
177879	12.9	*90.7*	*52.7*	10.1	8.8	9.9	69	48	3.15	3.1	3.65	3.7	*86.3*	*83.8*	4.9	2.6	*53.1*	5.4	6.2	*87.1*	3.6
177876	13.0		*52.3*	9.7	8.4	9.8	70	50	3.3	3.35	3.6	3.6	*91.7*	*93.1*	4.7	2.65	*56.4*	5.5	6.4	*85.9*	
177871	12.5		*56.0*	9.3	8.0	9.3	68	52	3.2	3.2	3.65	3.65	*87.7*	*87.7*	4.6	2.4	*52.2*	5.2	6.3	*82.5*	
176944									3.3	3.35	3.5	3.7	*94.3*	*90.5*	4.6	2.5	*54.4*				
176946	13.0		*55.4*	9.2	8.2	10.0	74	60	3.25	3.35	3.9	3.8	*83.3*	*88.2*	4.8	[2] 2.3	*47.9*				
176940	13.0	*89.2*	*53.9*	9.5	8.4	10.2	75	57	3.15	3.2	3.7	3.65	*85.1*	*87.7*	4.75	2.55	*53.7*	5.1	6.4	*79.7*	3.5
176943	(13.3)		*(52.6)*	8.8	7.6	9.4	72	53	3.5	3.4	3.7	3.7	*94.6*	*91.9*	4.85	2.6	*53.6*				
176951	(12.8)					9.1			3.5	3.5	3.85	3.75	*90.9*	*93.3*	4.8	2.4	*50.0*				
176948	13.0	*87.7*	*53.9*	9.2	7.8	9.6	71	50	3.5	3.4	3.7	3.7	*94.6*	*91.9*	4.8	2 3	*47.9*	5.2	6.1	*85.3*	3.25
213287	13.8		*55.1*	10.3	9.0	10.4	69	52	3.5	3.6	3.9	3.8	*89.7*	*94.7*	5.35	2.4	*44.9*	5.6	6.0	*93.3*	
213290	(13.7)		*(50.4)*	9.7	8.6	10.3	75	55	3.4	3.5	3.8	3.8	*89.5*	*92.1*	4.95	2.5	*50.5*	5.3	5.7	*93.0*	
213284	12.7		*52.8*	9.8	8.3	9.1	64	43	3.1	3.2	3.7	3.6	*83.8*	*88.9*	4.7	2.4	*51.1*	5.5	6.2	*88.7*	
213289	12.6		*55.6*	(9.9)	(8.5)	(9.6)	(67)	(52)	3.1	3.2	3.7	3.7	*83.8*	*86.5*	4.6	2.5	*54.4*	5.4	6.6	*81.8*	
213298	(13.6)		*(53.7)*	9.9	8.6	10.0	70	51	3.45	3.45	3.65	3.65	*94.5*	*94.5*	5.1	2.3	*45.1*	5.8	7.3	*79.5*	
246971	12.9	*94.6*	*61.2*	10.0	8.3	9.8	65	47	3.4	3.5	3.9	3.9	*87.2*	*89.7*	5.25	2.8	*53.3*	5.9	[2] 6.5	*90.8*	3.8
246992	12.6	*96.0*	*56.4*						3.5		3.8		*92.1*		5.1	2.45	*48.0*	5.4	5.8	*93.1*	3.7
246997	12.5	*94.4*	*56.0*						3.2	3.1	3.65	3.7	*87.7*	*83.8*	4.55	2.55	*56.0*	5.3	6.1	*86.9*	3.7
246990	13.3	*83.5*	*51.1*	9.5	8.3	9.5	69	48	3.4	3.5	3.8	3.8	*89.5*	*92.1*	5.0	2.75	*55.0*	5.5	6.3	*87.3*	3.2
246994	12.8	*90.6*	*55.5*						3.3	3.25	3.6	3.6	*91.7*	*90.3*	4.65	2.6	*55.9*	5.8	6.7	*86.6*	3.7
270461	12.8					8.0	9.1		3.45	3.45	3.9	3.9	*88.5*	*88.5*	5.1	2.5	*49.0*				3.1
270464	13.4	*94.8*	*59.0*	9.5	8.0	9.6	66	48	3.75	3.75	3.9	3.9	*96.2*	*96.2*	5.5	[2] 2.6	*47.3*				
270466	12.0	*96.7*	*57.5*						3.6	3.65	3.6	3.6	*100.0*	*101.4*	4.9	2.2	*44.9*	5.0	6.1	*82.0*	3.15
270467	[2] 12.6	*88.1*	*52.4*						3.4	3.3	3.4	3.6	*100.0*	*91.7*	4.9	2.4	*49.0*	5.2	6.0	*86.7*	3.2
243906	12.8	*92.2*	*57.0*	10.8	9.0	10.0	64	43	3.4	3.35	3.85	3.8	*88.3*	*88.2*	4.9	2.5	*51.0*	5.9	6.6	*89.4*	3.8
243902	[2] 12.4		*56.5*	9.8	8.6	9.7	69	52	3.45	3.45	3.9	3.7	*88.5*	*95.2*	4.95	2.15	*48.4*	5.3	6.1	*86.9*	
243905	12.5		*55.2*	9.5	8.0	9.6	70	41	3.4	3.4	3.9	3.9	*87.2*	*87.2*	5.15	2.7	*52.4*	5.1	5.8	*87.9*	
157453	12.6								3.3		3.55		*93.0*		4.95	2.45	*49.5*				
157290	13.6		*51.2*	9.8	8.2	9.7	68	47	3.3	3.3	3.85	3.75	*85.7*	*88.0*	4.6	2.8	*60.9*	5.6	6.6	*84.9*	
329776	12.9	*86.8*	*53.5*		7.5	9.6			3.6	3.6	3.8	3.8	*94.7*	*94.7*	4.9	2.6	*53.1*				3.0

[2] Near.

PUEBLOS—Continued

DEFORMED ARIZONA CRANIA.—FEMALE—Continued

MISCELLANEOUS—Continued

Catalogue No.	Diam. Bizygomatic maximum. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth, maxim.	*Nasal Index*	Upper Alveolar Arch, length, maxim.	Upper Alveolar Arch, breadth, maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
							°	°													
254503																					
229363	13.4	*86.6*	*52.2*	9.6	8.2	9.5	68	44	3.4	3.35	3.8	3.75	*89.5*	*89.3*	5.2	2.7	*51.9*	5.3	6.3	*84.1*	3.4
317700	----	----	----	8.5	7.2	9.0	72	50	3.35	3.3	3.4	3.4	*98.5*	*97.1*	4.7	2.3	*48.9*	4.9	6.2	*79.0*	----
243938	----	----	----	----	----	----	----	----	----	3.5	----	3.9	----	*89.7*	----	----	----	----	----	----	----
213325	12.8	*87.5*	*53.1*	9.9	8.8	10.0	71	52	3.4	3.4	3.5	3.4	*97.1*	*100.0*	5.0	2.6	*52.0*	5.3	6.4	*82.8*	3.2
213324	12.9	*89.2*	*54.3*	9.9	8.6	10.4	74	51	3.45	3.45	3.7	3.6	*93.2*	*95.8*	4.95	2.7	*54.6*	5.4	6.0	*90.0*	3.4
243935	*(12.9)*	----	----	----	8.6	10.0	----	----	3.5	3.5	3.8	3.65	*92.1*	*95.9*	4.95	2.5	*50.5*	----	----	----	----
239201	13.0	*81.5*	----	----	----	----	----	----	3.6	3.55	3.9	3.95	*92.3*	*89.9*	4.85	2.5	*51.6*	----	----	----	----
Number of skulls	(29)	*(18)*	*(26)*	(24)	(27)	(28)	(24)	(24)	(38)	(36)	(33)	(36)	*(38)*	*(36)*	(37)	(37)	*(37)*	(27)	(27)	*(27)*	(19)
Totals	373.3	----	----	231.1	223.4	272.0	----	----	128.65	122.1	141.25	133.6	----	----	181.15	92.45	----	144.9	169.1	----	64.5
Averages	*12.87*	*89.82*	*54.61*	*9.66*	*8.26*	*9.71*	*70*	*49*	*3.39*	*3.39*	*3.72*	*3.71*	*91.08*	*91.39*	*4.90*	*2.50*	*51.04*	*5.37*	*6.26*	*85.69*	*3.39*
Minima	12.0	*81.5*	*50.8*	8.5	7.2	9.0	64	41	3.1	3.1	3.4	3.4	*88.3*	*88.3*	4.55	2.15	*48.4*	4.9	5.7	*79.0*	3.0
Maxima	13.8	*96.7*	*61.2*	10.8	9.0	10.4	75	60	3.75	3.75	3.9	3.95	*100.0*	*101.4*	5.5	2.8	*60.9*	5.9	7.3	*93.3*	3.8

DEFORMED COLORADO CRANIA—FEMALE

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. anteo-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	Cranial Index	Mean Height Index	Height-Breadth Index	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Alveol. Pt. - Nasion height (b)	Menton-Nasion height (a)
336,622	B. A. E.	Montezuma Canyon	22	Moderate	(14.7)	(14.3)	(13.8)	(97.3)	(95.2)	(96.5)	14.27	1,200	No wear	6.4	10.8

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbitis—Height, right	Orbitis—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	*Orbital Index, right*	*Orbital Index, left*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length, maxim.	Upper Alveolar Arch, breadth, maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
336,622	12.6	85.7	50.8	9.4	8.2	9.4	° 70	° 51	3.2	3.2	3.5	3.6	91.43	88.89	4.4	2.5	56.82	5.2	6.3	82.54	3.25

PUEBLOS—Continued

ABSTRACT—MALE

UNDEFORMED CRANIA

Locality	Diam. antero-posterior maxim. (glabella-ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity in c. c. (Hrdlička's method)	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a\times100}{c}\right)$	*Facial Index, upper* $\left(\frac{b\times100}{c}\right)$	Basion-Alveolar Pt.
NEW MEXICO														
Téwas:														
Puyé (6)—														
Specimens	(6)	(6)	(6)	(6)	(6)	(6)	(4)	(4)	(4)	(5)	(3)	(3)	(3)	(5)
Totals	99.0	83.0	81.1					5,375	44.6	33.3	40.8			48.7
Means	*16.5*	*13.83*	*13.52*	*83.8*	*89.1*	*97.7*	*14.89*	*1,344*	*11.15*	*6.66*	*13.6*	*82.8*	*49.8*	*9.74*
Otowí (3)—														
Specimens	(3)	(3)	(2)	(3)	(2)	(2)				(2)	(3)		(2)	(2)
Totals	50.8	40.6	26.3							14.2	27.7			20.1
Means	*16.93*	*13.53*	*13.15*	*79.9*	*84.8*	*96.0*				*7.1*	*13.85*		*52.0*	*10.05*
Kwasteyukwa (3)—														
Specimens	(2)	(3)	(3)	(2)	(2)	(3)	(2)	(2)	(3)	(3)	(3)	(3)	(3)	(3)
Totals	34.9	40.8	41.7						36.7	22.1	41.5			30.0
Means	*17.45*	*13.6*	*13.9*	*79.1*	*88.0*	*102.2*	*15.0*	*1,339*	*12.2*	*7.37*	*13.83*	*88.4*	*53.25*	*10.0*
Giusiwa (3)—														
Specimens	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(2)	(2)	(2)	(2)
Totals	51.7	41.1	40.5						35.4	20.6	26.6			19.7
Means	*17.23*	*13.7*	*13.5*	*79.5*	*87.3*	*98.5*	*14.81*	*1,367*	*11.8*	*6.87*	*13.3*	*84.1*	*50.7*	*9.85*
Old Zuñi:														
Havikuh (34)—														
Specimens	(34)	(34)	(30)	(34)	(30)	(30)	(30)	(27)	(29)	(32)	(31)	(28)	(30)	(23)
Totals	597.6	453.4	400.6					35,235	353.5	234.7	416.8			225.4
Means	*17.58*	*13.34*	*13.35*	*75.9*	*86.4*	*100.1*	*14.76*	*1,305*	*12.19*	*7.33*	*13.45*	*90.5*	*54.3*	*9.8*

Miscellaneous:														
Dolichocranic (3). Near Durango, near Santa Fe, Gran Quivira—														
Specimens	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)		(2)	(3)		(2)	(1)
Totals	54.4	39.9	40.1					4.165		15.1	41.1			10.1
Means	*18.13*	*13.3*	*13.37*	*73.3*	*85.0*	*100.5*	*14.93*	*1,388*		*7.55*	*13.7*		*53.9*	
Mesocranic (3). Near Fort Union, New Mexico, Mimbres Valley—														
Specimens	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)		(3)	(3)		(3)	(3)
Totals	53.3	41.0	40.7							22.7	41.37			30.8
Means	*17.77*	*13.83*	*13.57*	*77.8*	*85.9*	*98.1*	*15.06*	*1,385*		*7.57*	*13.7*		*55.0*	*10.27*
Brachycranic (3). Lower Mimbres, Coolidge, Kinbenaiola—														
Specimens	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Totals	50.7	42.8	41.9					3,975	34.8	21.7	42.4			30.2
Means	*16.9*	*14.27*	*13.97*	*84.4*	*89.6*	*97.9*	*15.04*	*1,325*	*11.6*	*7.23*	*14.13*	*82.1*	*51.2*	*10.07*
ARIZONA														
Salt River (2):														
Specimens	(2)	(2)	(1)	(2)	(1)	(1)	(1)	(2)						
Totals	37.8	28.5	13.8		84.4	97.9	15.50	3,015						
Means	*18.9*	*14.25*		*75.4*				*1,508*						
Miscellaneous (3):														
MacDonald Canyon, near Holbrook, Four-Mile Canyon—														
Specimens	(3)	(3)	(2)	(3)	(2)	(2)	(2)	(2)	(1)	(2)	(2)		(2)	(2)
Totals	50.3	42.3	27.2					2,625	12.0	14.9	25.9			19.1
Means	*16.8*	*14.1*	*13.6*	*84.1*	*88.2*	*96.8*	*14.82*	*1,312*		*7.45*	*12.95*		*57.5*	*9.55*

PUEBLOS—Continued

ABSTRACT—MALE—Continued

UNDEFORMED CRANIA.—Continued.

Locality	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, Mean	Orbits—Breadth, Mean	*Orbital Index, Mean*	Nose, height	Nose, Breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
NEW MEXICO														
Tewas:														
Puyé (6)—			°	°										
Specimens	(5)	(6)	(5)	(5)	(4)	(4)	(4)	(5)	(5)	(5)	(4)	(4)	(4)	(5)
Totals	43.5	60.0						23.9	12.55		21.1	25.3		16.2
Means	*8.7*	*10.0*	*72.0*	*54.0*	*3.42*	*3.72*	*92.0*	*4.78*	*2.51*	*52.5*	*5.28*	*6.33*	*83.4*	*3.25*
Otowi (3)—														
Specimens	(2)	(2)	(2)	(2)	(3)	(3)	(3)	(2)	(2)	(2)	(2)	(2)	(2)	
Totals	17.4	19.8						10.3	5.4		10.7	13.0		
Means	*8.7*	*9.9*	*67.5*	*45.5*	*3.58*	*3.70*	*96.8*	*5.15*	*2.7*	*52.4*	*5.35*	*6.5*	*82.3*	
Kwasteyukwa (3)—														
Specimens	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Totals	25.9	30.4						15.15	7.8		16.8	20.3		10.5
Means	*8.6*	*10.13*	*69.3*	*50.0*	*3.51*	*3.79*	*92.5*	*5.05*	*2.6*	*51.5*	*5.6*	*6.77*	*82.8*	*3.5*
Giusiwa (3)—														
Specimens	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(3)	(2)	(2)	(2)	(3)
Totals	16.9	19.2						14.2	7.6		11.2	15.3		10.2
Means	*8.45*	*9.6*	*68.0*	*48.5*	*3.39*	*3.70*	*89.2*	*4.73*	*2.5*	*52.8*	*5.6*	*6.65*	*84.2*	*3.4*
Old Zuñi:														
Havikuh (34)—														
Specimens	(25)	(27)	(23)	(23)	(30)	(30)	(30)	(32)	(32)	(32)	(27)	(27)	(27)	(30)
Totals	213.2	268.6						163.15	80.5		116.4	174.8		109.6
Means	*8.53*	*9.95*	*70.0*	*52.0*	*3.49*	*3.79*	*92.3*	*5.10*	*2.52*	*49.3*	*5.42*	*6.47*	*83.8*	*3.65*

Miscellaneous:														
Dolichocranic (3). Near Durango, near Santa Fe, Gran Quivira—														
Specimens	(3)	(3)	(1)	(1)	(3)	(3)	(3)	(3)	(3)	(3)				
Totals	26.6	31.4	72.0	49.0				16.1	8.07					
Means	*8.87*	*10.47*			*3.53*	*3.97*	*88.9*	*5.37*	*2.6*	*49.7*				
Mesocranic (3). Near Fort Union, New Mexico, Mimbres Valley—														
Specimens	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	
Totals	26.9	30.9						15.3	7.5		16.8	20.7		
Means	*8.97*	*10.3*	*69.0*	*53.0*	*3.42*	*3.80*	*89.9*	*5.1*	*2.5*	*49.0*	*5.6*	*6.9*	*81.2*	
Brachycranic (3). Lower Mimbres, Coolidge, Kinbenaiola—														
Specimens	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Totals	25.8	30.4						15.0	7.55		17.0	19.6		10.9
Means	*8.6*	*10.13*	*69.7*	*48.3*	*3.32*	*3.87*	*85.8*	*5.0*	*2.52*	*50.3*	*5.67*	*6.53*	*86.7*	*3.33*
ARIZONA														
Salt River (2):														
Specimens														
Totals														
Means														
Miscellaneous (3):														
MacDonald Canyon, near Holbrook, Four-Mile Canyon—														
Specimens	(3)	(3)	(2)	(2)	(4)	(4)	(4)	(4)	(4)	(4)	(2)	(2)	(2)	(1)
Totals	25.7	29.7						20.3	10.1		10.7	12.6		3.4
Means	*8.57*	*9.9*	*69.0*	*49.5*	*3.46*	*3.74*	*92.6*	*5.1*	*2.6*	*49.8*	*5.35*	*6.3*	*85.0*	

PUEBLOS—Continued

ABSTRACT.—FEMALE

UNDEFORMED CRANIA

Locality	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity in c. c. (Hrdlička's method)	Menton-Nasion height (a)	Alveol. Pt.-Nasion Height (b)	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a\times100}{c}\right)$	*Facial Index, upper* $\left(\frac{b\times100}{c}\right)$	Basion-Alveolar Pt.
NEW MEXICO														
Téwa:														
Puyé (3)—														
Specimens	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(1)	(2)	(2)	(1)	(2)	(2)
Totals	48.9	40.9	38.7					3,670	10.9	13.8	27.1	82.6		20.4
Means	*16.3*	*13.63*	*12.9*	*83.6*	*86.2*	*94.6*	*14.28*	*1,223*		*6.9*	*13.55*		*50.9*	*10.2*
Dolichocranic (5). 2 Puye intrusive, 2 Giusiwa intrusive, 1 Kwasteyukwa intrusive—														
Specimens	(5)	(5)	(3)	(5)	(3)	(3)	(3)	(4)	(3)	(3)	(2)	(2)	(2)	(2)
Totals	87.1	63.1	37.9					4,815	33.2	20.3	25.5			18.7
Means	*17.42*	*12.62*	*12.63*	*72.4*	*84.2*	*98.9*	*14.21*	*1,204*	*11.07*	*6.77*	*12.75*	*87.5*	*53.3*	*9.35*
Mesocranic—Kwasteyukwa (3)—														
Specimens	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(1)	(2)	(2)	(2)			(2)
Totals	50.1	39.5	38.4					1,215	21.4	13.5	25.2			19.0
Means	*16.7*	*13.17*	*12.8*	*78.8*	*85.7*	*97.2*	*14.22*		*10.7*	*6.75*	*12.6*			*9.5*
Brachycranic—Kwasteyukwa (2)—														
Specimens	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)		(2)	(2)		(2)	(2)
Totals	31.9	27.3	25.7					1,190		14.1	25.6			19.1
Means	*15.95*	*13.65*	*12.85*	*85.6*	*86.8*	*94.2*	*14.15*			*7.05*	*12.8*		*55.1*	*9.55*
Old Zuñi:														
Havikuh (51)—														
Specimens	(51)	(51)	(49)	(51)	(48)	(48)	(50)	(43)	(38)	(42)	(42)	(35)	(39)	(40)
Totals	836.0	669.6	625					50,135	430.1	286.3	533.4			375.7
Means	*16.39*	*13.13*	*12.76*	*80.1*	*86.5*	*97.1*	*14.69*	*1,166*	*11.32*	*6.82*	*12.76*	*89.2*	*53.6*	*9.39*

Miscellaneous (5):														
1 White Mountain, 2 Tulerosa, 1 Tshirege, 1 Chaco Canyon—														
Specimens	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)		(4)	(4)		(4)	(3)
Totals	66.2	53.3	52.5					4,955		26.2	50.8			26.9
Means	*16.55*	*13.32*	*13.12*	*76.9–84.8*	*87.9*	*98.6*	*14.34*	*1,239*		*6.55*	*12.7*		*52.8*	*8.97*
ARIZONA														
Salt River (4):														
Specimens	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)		(4)	(3)		(3)	(4)
Totals	67.8	51.9	53.0					4,855		27.5	38.3			38.1
Means	*16.95*	*12.97*	*13.25*	*76.5*	*88.5*	*102.1*	*14.39*	*1,214*		*6.87*	*12.77*		*54.3*	*9.52*
Miscellaneous (6):														
1 Four Mile Canyon, 1 Las Animas River, 2 Chaves Pass, 1 Tally Hogan, 1 Chevlon—														
Specimens	(6)	(6)	(4)	(6)	(4)	(4)	(4)	(3)		(4)	(1)		(3)	
Totals	98.8	79.7	51.1					3,630		27.6	50.4			
Means	*16.47*	*13.28*	*12.78*	*77.8–81.1*	*85.9*	*95.9*	*14.17*	*1,210*		*6.9*	*12.6*		*57.0*	

PUEBLOS—Continued

ABSTRACT.—FEMALE—Continued

UNDEFORMED CRANIA—Continued

Locality	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, Mean	Orbits—Breadth, Mean	*Orbital Index, Mean*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
NEW MEXICO														
Téwa:			°	°										
Puyé (3)—														
Specimens	(2)	(3)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)				(3)
Totals	17.2	28.6						9.5	5.05					10.1
Means	*8.6*	*9.53*	*68.0*	*44.0*	*3.42*	*3.82*	*89.5*	*4.75*	*2.53*	*53.2*				*3.37*
Dolichocranic (5). 2 Puye intrusive, 2 Giusiwa intrusive, 1 Kwasteyukwa intrusive—														
Specimens	(2)	(3)	(2)	(2)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(4)
Totals	16.0	28.2						14.7	7.5		15.9	18.4		13.3
Means	*8.0*	*9.4*	*67.0*	*46.5*	*3.59*	*3.73*	*96.2*	*4.9*	*2.5*	*51*	*5.3*	*6.13*	*86.4*	*3.32*
Mesocranic—Kwasteyukwa (3)—														
Specimens	(3)	(3)	(2)	(2)	(3)	(3)	(3)	(3)	(3)	(3)				(3)
Totals	23.9	27.5						14.2	7.2					9.1
Means	*7.97*	*9.17*	*68.0*	*50.0*	*3.39*	*3.70*	*91.6*	*4.73*	*2.4*	*50.7*				*3.03*
Brachycranic—Kwasteyukwa (2)—														
Specimens	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)				(2)
Totals	16.0	18.4						9.85	5.2					6.6
Means	*8.0*	*9.2*	*65.5*	*43.5*	*3.32*	*3.58*	*92.6*	*4.92*	*2.6*	*52.8*				*3.3*
Old Zuñi:														
Havikuh (51)—														
Specimens	(41)	(47)	(39)	(39)	(44)	(44)	(44)	(46)	(44)	(44)	(39)	(38)	(38)	(43)
Totals	335.5	444.3						220.55	111.1		205.1	234.9		143.05
Means	*8.18*	*9.45*	*69.0*	*51.0*	*3.43*	*3.66*	*93.7*	*4.79*	*2.53*	*52.7*	*5.26*	*6.18*	*85.1*	*3.32*

Miscellaneous (5)														
1 White Mountain, 2 Tulerosa, 1 Tshirege, 1 Chaco Canyon—														
Specimens	(3)	(5)	(3)	(3)	(4)	(4)	(4)	(3)	(3)	(3)	(3)	(3)	(3)	
Totals	23.9	48.3						14.55	7.65		14.6	17.9		
Means	7.97	9.66	73.0	51.0	3.39	3.71	91.4	4.85	2.55	52.6	4.87	5.97	81.6	
ARIZONA														
Salt River (4):														
Specimens		(4)	(4)		(4)	(4)	(4)	(4)	(4)	(4)	(3)	(3)	(3)	
Totals		39.2						14.55	7.65		14.6	17.9		
Means		9.8	71.0		3.39	3.77	89.9	4.85	2.55	52.6	4.87	5.97	81.6	
Miscellaneous (6):														
1 Four Mile Canyon, 1 Las Animas River, 2 Chaves Pass, 1 Tally Hogan, 1 Chevlon—														
Specimens	(4)	(4)			(5)	(5)	(5)	(4)	(4)	(4)	(2)	(2)	(2)	
Totals	16.5	37.7						19.7	10.0		10.7	12.7		
Means	8.25	9.42			3.44	3.61	95.4	4.92	2.5	50.8	5.35	6.35	84.3	

PUEBLOS—Continued

ABSTRACT.—MALE

DEFORMED CRANIA

Locality	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity in c. c. (Hrdlička's method)	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.
NEW MEXICO														
Téwa:														
Puyé (17)—														
Specimens							(15)	(13)	(12)	(15)	(9)	(7)	(8)	(11)
Total								17,515	141.7	108.0	120.6			105.9
Means							*14.86*	*1,347*	*11.81*	*7.2*	*13.4*	*88.2*	*52.3*	*9.63*
Other Téwa (17)—														
Specimens							(13)	(12)	(12)	(15)	(14)	(10)	(12)	(11)
Total								16,360	143.0	108.8	191.9			111.1
Means							*15.0*	*1,363*	*11.92*	*7.25*	*13.71*	*85.7*	*52.9*	*10.1*
Pueblo:														
Bonito and Chaco Canyon (11)—														
Specimens							(7)	(9)	(9)	(11)	(7)	(5)	(7)	(8)
Total								12,230	110.6	79.7	94.4			75.2
Means							*15.21*	*1,359*	*12.29*	*7.25*	*13.49*	*90.6*	*53.4*	*9.4*
Old Zuñi:														
Havikuh (15)—														
Specimens							(10)	(10)	(10)	(12)	(9)	(8)	(8)	(8)
Total								13,310	120.0	86.3	120.0			77.9
Means							*14.72*	*1,331*	*12.0*	*7.19*	*13.33*	*88.1*	*53.0*	*9.74*
Miscellaneous (11):														
Specimens							(7)	(7)	(4)	(8)	(8)	(4)	(7)	(3)
Total								9,845	47.8	57.0	109.7			28.8
Means							*15.15*	*1,406*	*11.95*	*7.12*	*13.71*	*86.9*	*52.3*	*9.6*

ARIZONA														
Salt River (57):														
Specimens							(32)	(29)	(12)	(41)	(39)	(12)	(31)	(12)
Total								40,560	144.6	307.0	527.8			117.6
Means							*15.25*	*1,399*	*12.05*	*7.49*	*13.53*	*88.1*	*55.5*	*9.8*
Old Hopi (5):														
Specimens							(2)	(3)	(1)	(5)	(4)		(4)	
Total							29.8	4,150		37.7	53.6			
Means							*14.90*	*1,383*	11.7	*7.54*	*13.4*		*56.2*	
Elden (7):														
Specimens							(5)	(5)	(5)	(5)	(4)	(3)	(3)	(3)
Total								7,230	61.6	37.5	54.6			30.7
Means							*15.35*	*1,446*	*12.32*	*7.5*	*13.65*	*88.1*	*53.5*	*10.23*
Chaves Pass (18):														
Specimens							(15)	(13)		(11)	(6)		(6)	(9)
Total								18,500		81.8	80.3			89.1
Means							*15.13*	*1,423*		*7.44*	*13.38*		*54.9*	*9.9*
Petrified Forest (13):														
Specimens							(11)	(11)	(10)	(12)	(8)	(7)	(8)	(8)
Total								15,415	121.8	88.7	107.5			79.7
Means							*15.01*	*1,401*	*12.18*	*7.39*	*13.44*	*90.1*	*54.3*	*9.96*
Miscellaneous (33):														
Specimens							(22)	(24)	(13)	(31)	(15)	(8)	(15)	(16)
Total								33,110	158.5	229.0	203.3			157.5
Means							*14.94*	*1,380*	*12.19*	*7.39*	*13.55*	*89.3*	*54.6*	*9.84*
COLORADO														
Mesa Verde (2), Montezuma Canyon (1):														
Specimens							(3)	(3)	(3)	(3)				(2)
Total								4,440	37.7	22.8				19.6
Means							*15.55*	*1,480*	*12.57*	*7.6*				*9.8*

PUEBLOS—Continued

ABSTRACT.—MALE—Continued

DEFORMED CRANIA—Continued

Locality	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, Mean	Orbits—Breadth, Mean	*Orbital Index, Mean*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
NEW MEXICO														
Téwa:														
Puyé (17)—			°	°										
Specimens	(11)	(13)	(9)	(9)	(15)	(15)	(15)	(17)	(17)	(17)	(11)	(11)	(11)	(12)
Totals	93.9	126.7						84.5	41.05		58.7	69.9		41.45
Means	*8.54*	*9.75*	*69*	*56*	*3.45*	*3.80*	*90.9*	*4.97*	*2.41*	*48.6*	*5.34*	*6.35*	*84.0*	*3.45*
Other Téwa (17)—														
Specimens	(12)	(14)	(11)	(11)	(14)	(14)	(14)	(17)	(16)	(16)	(13)	(14)	(13)	(12)
Total	104.7	138.9						84.6	42.1		72.8	91.4		43.25
Means	*8.72*	*9.92*	*68*	*49.5*	*3.46*	*3.83*	*90.5*	*4.98*	*2.63*	*52.8*	*5.6*	*6.53*	*85.9*	*3.6*
Pueblo:														
Bonito and Chaco Canyon (11)														
Specimens	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(11)	(11)	(11)	(7)	(7)	(7)	(9)
Total	66.9	79.9						56.85	27.65		36.6	44.9		32.2
Means	*8.36*	*9.99*	*73*	*57*	*3.49*	*3.82*	*91.4*	*5.17*	*2.51*	*48.6*	*5.23*	*6.7*	*81.5*	*3.58*
Old Zuñi:														
Havikuh (15)—														
Specimens	(9)	(11)	(8)	(8)	(11)	(11)	(11)	(12)	(12)	(12)	(8)	(9)	(8)	(11)
Total	76.8	107.2						60.8	30.1		42.9	58.2		38.25
Means	*8.53*	*9.75*	*69*	*54*	*3.49*	*3.81*	*92.1*	*5.07*	*2.51*	*49.5*	*5.36*	*6.47*	*83.1*	*3.48*
Miscellaneous (11):														
Specimens	(5)	(7)	(3)	(3)	(9)	(9)	(9)	(9)	(9)	(9)	(6)	(7)	(6)	(5)
Total	41.5	70.0						43.95	22.7		32.8	45.4		17.65
Means	*8.3*	*10.0*	*71*	*54*	*3.43*	*3.82*	*89.8*	*4.88*	*2.52*	*51.6*	*5.47*	*6.49*	*85.4*	*3.53*

ARIZONA														
Salt River (57):														
Specimens		(15)	(10)		(50)	(48)	(48)	(52)	(51)	(51)	(38)	(32)	(32)	
Total		150.3						273.0	129.6		202.9	208.3		
Means		*10.0*	*71*		*3.50*	*3.83*	*91.6*	*5.25*	*2.54*	*48.4*	*5.34*	*6.51*	*82.0*	
Old Hopi (5):														
Specimens					(5)	(5)	(5)	(5)	(5)	(5)	(4)	(4)	(4)	
Total								25.85	12.85		22.5	26.2		
Means					*3.50*	*3.90*	*89.9*	*5.17*	*2.57*	*49.7*	*5.63*	*6.55*	*85.9*	
Elden (7):														
Specimens	(4)	(5)	(3)	(3)	(6)	(6)	(6)	(7)	(7)	(7)	(4)	(4)	(4)	(7)
Total	34.8	50.4						36.15	18.4		22.5	27.6		25.7
Means	*8.7*	*10.08*	*69*	*51*	*3.42*	*3.83*	*89.3*	*5.16*	*2.63*	*50.9*	*5.63*	*6.9*	*81.5*	*3.67*
Chaves Pass (18):														
Specimens	(11)	(15)	(9)	(9)	(15)	(15)	(15)	(16)	(16)	(16)	(10)	(10)	(10)	
Total	94.6	151.9						82.2	38.95		55.2	65.1		
Means	*8.6*	*10.13*	*69*	*52*	*3.53*	*3.84*	*92.1*	*5.14*	*2.43*	*47.4*	*5.52*	*6.51*	*84.8*	
Petrified Forest (13):														
Specimens	(8)	(9)	(8)	(8)	(10)	(10)	(10)	(12)	(12)	(12)	(12)	(12)	(12)	(11)
Total	69.2	90.8						62.2	29.85		66.4	80.6		39.35
Means	*8.65*	*10.09*	*70*	*51*	*3.52*	*3.75*	*93.8*	*5.18*	*2.49*	*48.0*	*5.53*	*6.72*	*82.4*	*3.58*
Miscellaneous (33):														
Specimens	(19)	((19)	(16)	(16)	(30)	(30)	(30)	(33)	(33)	(33)	(27)	(27)	(27)	(19)
Total	163.3	189.8						167.3	83.05		147.1	175.7		68.15
Means	*8.59*	*9.99*	*69*	*52*	*3.48*	*3.83*	*90.9*	*5.07*	*2.52*	*49.6*	*5.45*	*6.51*	*83.7*	*3.59*
COLORADO														
Montezuma Canyon (1): Mesa Verde (2),														
Specimens	(2)	(2)	(2)	(2)	(3)	(3)	(3)	(3)	(3)	(3)	(2)	(2)	(2)	(3)
Total	17.0	20.3						15.6	7.8		10.7	14.1		11.2
Means	*8.5*	*10.15*	*71*	*53*	*3.39*	*3.90*	*86.8*	*5.2*	*2.6*	*50.0*	*5.35*	*7.05*	*(75.9)*	*3.73*

PUEBLOS—Continued

ABSTRACT.—FEMALE

DEFORMED CRANIA—Continued

Locality	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity in c. c. (Hrdlička's method)	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a\times100}{c}\right)$	*Facial Index, upper* $\left(\frac{b\times100}{c}\right)$	Basion-Alveolar Pt.
NEW MEXICO														
Téwa:														
Puyé (30)—														
Specimens							(26)	(23)	(23)	(25)	(19)	(14)	(15)	(17)
Totals								27,320	254.4	169.2	240.1			156.3
Means							*14.13*	*1,188*	*11.06*	*6.77*	*12.64*	*88.1*	*53.7*	*9.19*
Other Tewa (34)—														
Specimens							(27)	(23)	(20)	(30)	(24)	(18)	(24)	(26)
Totals								28,170	222.8	203.9	310.3			245.1
Means							*14.35*	*1,225*	*11.14*	*6.8*	*12.93*	*86.1*	*52.9*	*9.43*
P. Bonito and Chaco Canyon (7)—														
Specimens							(6)	(6)	(2)	(6)	(3)		(2)	(3)
Totals								7,680	22.9	40.4	38.4			28.0
Means							*14.74*	*1,280*	*11.45*	*6.73*	*12.8*		*51.0*	*9.33*
Old Zuñi:														
Havikuh (18)—														
Specimens							(13)	(14)	(15)	(15)	(8)	(8)	(7)	(11)
Totals								16,780	165.6	100.4	100.9			101.3
Means							*14.29*	*1,199*	*11.04*	*6.69*	*12.61*	*86.9*	*52.7*	*9.21*
Miscellaneous (8):														
Specimens							(7)	(6)	(6)	(7)	(7)	(6)	(6)	(7)
Totals								7,600	64.8	47.3	90.2			64.9
Means							*14.52*	*1,267*	*10.8*	*6.76*	*12.89*	*84.8*	*52.7*	*9.27*

ARIZONA

Salt River (62):														
Specimens							(43)	(42)	(14)	(46)	(46)	(13)	(37)	(37)
Totals								51,715	159.7	318.6	588.1			261.7
Means							*14.55*	*1,231*	*11.41*	*6.93*	*12.78*	*89.2*	*54.8*	*9.69*
Old Hopi (3):														
Specimens							(2)	(3)		(2)	(3)		(2)	
Totals								3,735		13.8	38.3			
Means							*14.80*	*1,245*		*6.9*	*12.77*		*54.6*	
Elden (6):														
Specimens							(3)	(3)	(5)	(6)	(4)	(3)	(4)	
Totals								3,950	57.6	42.0	50.7			
Means							*14.60*	*1,317*	*11.52*	*7.0*	*12.68*	*93.8*	*56.0*	
Chaves Pass (17):														
Specimens							(15)	(15)		(14)	(10)		(10)	(12)
Totals								18,550		97.2	126.6			115.9
Means							*14.36*	*1,237*		*6.94*	*12.66*		*51.3*	*9.66*
Petrified Forest (6):														
Specimens							(6)	(5)	(5)	(5)	(31)	(3)	(3)	(4)
Totals								6,370	56.0	34.3	38.5			38.0
Means							*14.51*	*1,274*	*11.2*	*6.86*	*12.83*	*87.3*	*53.5*	*9.5*
Miscellaneous (40):														
Specimens							(35)	(31)	(19)	(31)	(29)	(18)	(26)	(24)
Totals									219.3	217.7	373.3			231.1
Means							*14.47*	*1,253*	*11.54*	*7.02*	*12.87*	*89.8*	*54.6*	*9.63*

NOTE.—For Colorado (1) see detailed data.

PUEBLOS—Continued

ABSTRACT.—FEMALE—Continued

DEFORMED CRANIA—Continued

Locality	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, Mean	Orbits—Breadth, Mean	*Orbital Index, Mean*	Nose, height	Nose, breadth maxim.	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
NEW MEXICO														
Téwa:														
Puyé (30)—														
Specimens	(18)	(18)	(16)	(16)	(19)	(19)	(19)	(27)	(27)	(27)	(22)	(21)	(21)	(20)
Totals	144.0	166.4						128.3	66.65		113.2	125.6		65.55
Means	*8.0*	*9.24*	*69*	*52*	*3.37*	*3.64*	*92.8*	*4.75*	*2.47*	*51.9*	*5.15*	*5.98*	*86.0*	*3.28*
Other Téwa (34)—														
Specimens	(26)	(28)	(24)	(23)	(26)	(26)	(26)	(30)	(30)	(30)	(26)	(26)	(26)	(22)
Totals	213.4	265.3						143.35	74.65		136.4	160.3		71.4
Means	*8.21*	*9.47*	*69*	*51*	*3.39*	*3.67*	*93.0*	*4.78*	*2.49*	*52.1*	*5.25*	*6.17*	*85.1*	*3.25*
P. Bonito and Chaco Canyon (7)—														
Specimens	(3)	(4)	(3)	(3)	(6)	(6)	(6)	(6)	(6)	(6)	(4)	(3)	(3)	(3)
Totals	25.2	38.9						29.2	14.8		20.0	18.7		10.1
Means	*8.4*	*9.72*	*74*	*57*	*3.45*	*3.75*	*89.2*	*4.87*	*2.47*	*50.7*	*5.0*	*6.23*	*(98.5)*	*3.37*
Old Zuñi:														
Havikuh (18)—														
Specimens	(11)	(14)	(11)	(10)	(16)	(16)	(16)	(15)	(15)	(15)	(14)	(14)	(14)	(17)
Totals	89.4	129.4						70.85	37.6		71.4	87.2		55.7
Means	*8.13*	*9.24*	*69*	*51*	*3.38*	*3.74*	*89.9*	*4.72*	*2.51*	*53.1*	*5.10*	*6.23*	*82.4*	*3.28*
Miscellaneous (8):														
Specimens	(8)	(8)	(7)	(7)	(8)	(8)	(8)	(8)	(8)	(8)	(6)	(6)	(6)	(6)
Totals	64.2	75.7						37.6	19.2		31.0	37.4		18.65
Means	*8.03*	*9.46*	*71*	*52*	*3.39*	*3.71*	*91.5*	*4.7*	*2.4*	*51.1*	*5.17*	*6.23*	*82.9*	*3.11*

ARIZONA

Salt River (62):														
Specimens		(32)	(26)		(55)	(55)	(55)	(54)	(54)	(53)	(42)	(40)	(39)	
Totals		314.1						263.9	134.9		218.3	245.3		
Means		*9.81*	*70*		*3.43*	*3.73*	*91.9*	*4.89*	*2.5*	*51.2*	*5.2*	*6.13*	*85.2*	
Old Hopi (3):														
Specimens		(2)			(5)	(5)	(5)	(3)	(3)	(3)				
Totals		19.2						14.65	7.45					
Means		*9.6*			*3.50*	*3.63*	*96.6*	*4.88*	*2.48*	*50.9*				
Elden (6):														
Specimens					(6)	(6)	(6)	(6)	(6)	(6)	(5)	(5)	(5)	(6)
Totals								30.3	14.95		25.4	31.8		19.5
Means					*3.47*	*3.68*	*94.2*	*5.05*	*2.49*	*49.3*	*5.08*	*6.36*	*79.9*	*3.25*
Chaves Pass (17):														
Specimens	(12)	(16)	(12)	(12)	(15)	(15)	(15)	(15)	(15)	(15)	(11)	(11)	(11)	
Totals	101.4	153.9						73.15	36.7		58.7	69.9		
Means	*8.45*	*9.62*	*69*	*52*	*3.40*	*3.73*	*90.6*	*4.88*	*2.45*	*50.2*	*5.34*	*6.35*	*84.0*	
Petrified Forest (6):														
Specimens	(4)	(4)	(4)	(4)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Totals	32.4	37.7						24.05	12.55		26.5	31.9		16.2
Means	*8.4*	*9.43*	*69*	*48*	*3.40*	*3.71*	*91.8*	*4.81*	*2.51*	*52.2*	*5.3*	*6.38*	*83.1*	*3.24*
***Miscellaneous* (40):**														
Specimens	(27)	(28)	(21)	(21)	(38)	(38)	(38)	(37)	(37)	(37)	(27)	(37)	(27)	(19)
Totals	223.4	272.0						181.1	92.45		144.9	169.1		64.5
Means	*8.27*	*9.71*	*70*	*49*	*3.39*	*3.71*	*91.2*	*4.9*	*2.5*	*51.0*	*5.37*	*6.26*	*85.7*	*3.39*

BASKET-MAKERS

SOUTHEASTERN UTAH, ROCKSHELTERS, CRANIA

MALE

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean height Index*	*Height–Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)
306	U. S. N. M. (Hyde Expedition).	Grand Gulch Region	Adult		19.0	[1]12.4	13.7	*65.3*	*87.3*	*110.5*	15.03	.....	Moderate	12.0
92	do	do	do		18.2	12.5	13.0	*68.7*	*84.7*	*104.0*	14.57	1,230	do	13.0
378	do	do	do		18.3	12.6	13.1	*68.9*	*84.8*	*104.0*	14.67	1,315	Considerable	
179	do	do	do		18.0	12.4	13.7	*68.9*	*90.1*	*110.5*	14.70	1,300	Nearly all lost	
379	do	do	do		18.0	12.4	13.7	*68.9*	*90.1*	*110.5*	14.70	1,285	Considerable	
823	do	do	do		18.1	12.5	13.2	*69.1*	*86.3*	*105.6*	14.60	1,285	Slight	
245	do	do	do		18.2	12.8	13.4	*70.3*	*86.5*	*104.7*	14.80	1,280	do	12.4
79	do	do	do		18.7	13.2	13.8	*70.6*	*86.5*	*104.6*	15.23	1,360	do	12.6
239	do	do	do		18.6	13.2	13.4	*71.0*	*84.5*	*101.5*	15.07	1,460	Moderate	
275	do	do	do		18.0	12.8	13.4	*71.1*	*87.0*	*104.7*	14.73	1,300	do	
196	do	do	do		19.0	[1]13.5	.....	*71.1*	.....	.....	.....	.....	Slight	
228	do	do	do		18.1	12.9	13.6	*71.3*	*87.7*	*105.4*	14.87	1,270	.....	
93	do	do	do		18.0	12.9	13.5	*71.7*	*87.4*	*104.7*	14.80	1,370	.....	11.1
1008	do	do	do		17.8	12.8	13.4	*71.9*	*87.6*	*104.7*	14.67	1,270	Considerable	
271	do	do	do		18.2	13.1	13.0	*72.0*	*83.1*	*99.2*	14.77	1,310	do	11.5
270	do	do	do		18.5	13.4	12.8	*72.4*	*80.8*	*95.5*	14.90	1,355	Slight	13.9
133	do	do	do		18.1	13.1	12.8	*72.4*	*84.1*	*97.7*	14.67	1,395	Moderate	
419	do	do	do		17.7	12.9	12.9	*72.9*	*84.3*	*100.0*	14.50	1,320	.....	11.2
320	do	do	do		18.0	13.2	13.0	*73.3*	*85.3*	*98.5*	14.73	1,315	Slight	
246	do	do	do		18.1	13.4	.....	*74.0*	.....	.....	.....	.....	Moderate	
74	do	do	do		17.7	13.1	13.3	*74.0*	*86.4*	*101.5*	14.70	1,325	.....	11.8
860	do	do	do		17.8	13.3	13.0	*74.7*	*83.6*	*97.7*	14.70	1,305	.....	
187	do	do	do		17.9	13.4	12.8	*74.9*	*81.8*	*95.5*	14.70	1,310	No wear	
a	do	do	do		18.0	13.5	13.4	*75.0*	*85.1*	*99.8*	14.97	1,310	do	11.6
504	do	do	do		17.8	[1]13.4	13.1	*75.3*	*84.0*	*97.8*	14.77	.....	do	11.6

104	do	do	do		18.0	13.8	13.8	76.7	86.8	100.0	15.20	1,310	Considerable.	[1] 13.2
643	do	do	do	Slight asymmetry	18.1	13.9	13.3	76.8	83.1	95.7	15.10	1,495	No wear	12.3
75	do	do	do		18.2	14.0	14.4	76.9	89.4	102.9	15.53	1,470		12.1
76	do	do	do		18.2	14.0	13.6	76.9	84.5	97.1	15.27	1,410	Moderate	12.8
304	do	do	do		17.7	13.7		77.4					Slight	12.2
189	do	do	do		17.8	13.8	13.3	77.5	84.2	96.4	14.97	1,400	do	11.9
602	do	do	do		17.6	13.8	13.2	78.4	84.1	95.7	14.87	1,395	Moderate	10.9
80	do	do	do		17.0	13.5	13.2	79.4	86.6	97.8	14.57	1,340	do	12.8
1013	do	do	do	Moderate occipital compression.	(16.7)	(14.1)	(13.5)				14.77	1,200	do	11.5
55	do	do	do	Marked occipital compression.	(16.5)	(14.5)	(13.4)				14.80	1,330		11.9
138	do	do	do	do	(16.8)	(15.6)							Moderate	
1012	do	do	do	do	(16.6)	(15.8)	(14.4)				15.60	1,575		
288	do	do	do	Defective										
78	do	do	do	do										
316	do	do	do	do										
"j"	do	do	do	do										
240	do	do	do	do										
Number of skulls					(33)	(33)	(30)	(33)	(30)	(30)	(33)	(31)		(21)
Totals					596.4	435.2	399.8				490.53	41,595		254.3
Averages					*18.07*	*13.19*	*13.33*	*72.97*	*85.41*	*101.82*	*14.86*	*1,342*		*12.11*
Minima					17.0	12.4	12.8	*65.3*	*80.3*	*95.5*	14.50	1,200		10.9
Maxima					19.0	14.0	14.4	*79.4*	*90.1*	*110.5*	15.60	1,575		13.9

[1] Near.

BASKET-MAKERS—Continued

SOUTHEASTERN UTAH, ROCKSHELTERS, CRANIA—Continued

MALE

Catalogue No.	Alveol. Pt.-Nasion Height (b)	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, Mean	Orbits—Breadth, Mean	*Orbital Index, Mean*	Nose, height	Nose, breadth, maxim	*Nasal Index*	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, height at Symphysis
								°	°										
306	7.2	13.5	*88.9*	*53.3*	10.5	9.2	10.7	72	52	3.3	3.8	*86.8*	5.1	2.55	*50.0*	-------	7.0	-------	3.75
92	8.0	13.2	*98.5*	*60.6*	9.6	8.4	10.1	70	56	3.55	3.7	*96.0*	5.5	2.5	*45.5*	-------	7.0	-------	4.15
378	-------	12.5	-------	-------	-------	8.2	9.5	-------	-------	3.55	3.75	*94.7*	5.1	2.5	*49.0*	-------	-------	-------	3.2
179	-------	13.2	-------	-------	-------	8.0	9.7	-------	-------	3.50	3.75	*93.6*	4.9	2.4	*49.0*	-------	-------	-------	-------
379	-------	13.2	-------	-------	-------	8.5	9.8	-------	-------	3.6	3.7	*97.3*	5.0	2.35	*47.0*	-------	-------	-------	3.55
823	7.3	13.8	-------	*52.9*	10.6	9.4	10.3	68	56	3.5	4.13	*84.8*	4.8	2.35	*49.0*	-------	6.65	-------	-------
245	7.2	13.6	*91.2*	*52.9*	8.9	7.9	9.4	71	57	3.5	3.95	*88.6*	5.15	2.65	*51.5*	-------	6.7	-------	3.5
79	7.8	13.6	*92.6*	*57.4*	9.7	8.8	10.2	70	61	3.45	3.9	*88.5*	5.4	-------	-------	-------	6.75	-------	[1] 3.6
239	7.5	13.8	-------	*54.4*	10.5	9.2	10.0	66	52	3.40	3.65	*93.2*	5.15	2.5	*48.5*	-------	7.1	-------	-------
275	7.2	13.6	-------	*52.9*	8.9	7.9	9.6	72	56	3.50	3.80	*92.1*	5.2	2.75	*52.9*	-------	6.8	-------	-------
196	-------	-------	-------	-------	-------	-------	-------	-------	-------	3.4	3.72	*91.4*	5.3	2.6	*49.1*	-------	7.1	-------	-------
228	8.4	13.5	-------	*62.2*	10.0	8.6	10.2	67	53	3.65	3.85	*94.8*	5.75	2.7	*46.8*	-------	7.15	-------	-------
93	7.0	13.3	*83.5*	*52.6*	9.8	8.6	10.0	71	52	3.45	3.7	*93.2*	5.0	2.5	50.0	-------	6.85	-------	3.5
1008	7.2	13.1	-------	*55.0*	10.0	8.9	10.1	70	57	3.38	3.8	*89.0*	4.85	2.5	*51.5*	-------	6.3	-------	-------
271	7.3	12.9	*89.2*	*56.6*	9.8	8.5	9.7	68	49	3.7	3.75	*98.7*	5.3	2.55	*48.1*	-------	6.6	-------	3.15
270	8.1	13.5	*103.0*	*60.0*	9.8	8.2	9.8	66	51	3.5	3.75	*93.3*	5.3	2.7	*50.9*	-------	6.7	-------	4.35
133	7.0	13.2	-------	*53.0*	9.1	8.2	9.8	74	53	3.2	3.5	*91.4*	5.1	2.5	*49.0*	-------	6.6	-------	-------
419	6.8	13.3	*84.2*	*51.1*	9.3	8.2	9.4	70	55	3.3	3.7	*89.2*	4.7	2.6	*55.3*	-------	6.5	-------	3.45
320	7.5	12.8	-------	*58.6*	9.4	8.6	9.8	70	63	3.4	3.75	*90.7*	5.15	2.65	*51.5*	-------	6.0	-------	-------
246	8.1	[1] 13.5	-------	*60.0*	-------	-------	-------	-------	-------	3.45	3.8	*90.8*	5.5	2.6	*47.3*	-------	7.55	-------	-------
74	7.1	13.2	*89.4*	*53.8*	9.8	8.5	9.9	70	49	3.7	3.82	*96.9*	5.1	2.35	*46.1*	-------	6.1	-------	3.7
860	-------	13.4	-------	-------	-------	8.5	10.0	-------	-------	3.67	3.82	*96.1*	5.3	2.75	*51.9*	-------	-------	-------	3.2
187	7.5	13.2	-------	*56.8*	9.8	8.6	10.1	70	52	3.52	3.97	*88.7*	5.5	2.65	*48.2*	-------	6.8	-------	-------
a	7.1	13.3	*87.2*	*53.4*	9.2	8.1	9.4	70	56	3.43	3.53	*97.2*	4.85	2.55	*52.6*	-------	6.65	-------	3.1
504	7.0	13.2	*87.9*	*53.0*	9.6	8.5	10.0	72	50	3.75	3.98	*94.2*	5.25	2.55	*48.6*	-------	6.5	-------	3.25
104	8.4	14.2	*93.0*	*59.2*	9.7	8.7	10.6	72	-------	3.65	-------	-------	-------	-------	-------	-------	[1] 6.7	-------	3.6
643	7.4	13.2	*93.2*	*56.1*	9.5	8.3	9.3	66	55	3.4	3.9	*87.2*	5.0	2.7	*54.0*	-------	6.5	-------	3.8

75	7.2	14.0	86.4	51.4	9.8	8.9	10.3	73	57	3.3	3.87	85.3	5.35	2.3	43.0			6.75		3.5
76	7.9	14.2	90.1	56.6	9.9	8.7	10.2	69	54	3.6	3.9	92.3	5.65	2.4	46.7			6.6		3.9
304	7.3	14.0	87.1	52.1						3.55		92.2	4.85	2.4	49.5			6.7		3.75
189	7.1	13.8	86.2	51.4	10.1	8.9	10.0	69	53	3.35	3.7	90.5	5.0	2.65	53.0			6.8		3.6
602	7.0	12.8	85.2	54.2	9.3	8.3	9.6	71	58	3.47	3.82	90.8	4.75	2.45	51.6			5.9		3.3
80	7.4	14.3	89.5	51.8	9.8	8.4	9.5	66	49	3.45	3.8	90.8	5.1	2.4	47.1			6.3		4.0
1013	7.3	13.5	85.2	54.1	9.6	8.3	10.0	71	53	3.37	3.92	86.0	4.95	2.35	42.5			6.6		3.35
55	7.0	13.2	90.2	53.0	9.4	8.3	9.8	72	55	3.17	3.82	83.0	4.9	2.45	50.0			6.25		3.55
138	6.6									3.6	3.9	92.3	4.6	2.5	54.4			6.4		
1012	7.3	14.3		51.0	9.1	7.9	9.5	70	51	3.52	3.97	88.7	5.25	2.45	46.7			6.5		
288	7.3	14.3		51.0						3.32	3.85	86.2	5.05	2.5	49.5					
78										3.25	3.6	90.3	5.15	2.6	50.3					
316										3.55	3.87	91.7	5.1	2.65	52.0					
45[1]													5.35	2.5	46.7					
240													5.2	2.35	45.2					
Number of skulls		(23)	(36)	(21)	(32)	(29)	(33)	(33)	(24)	(28)	(10)	(39)	(39)	(41)	(40)	(40)		(33)		(24)
Totals		213.5	358.2	89.61	54.72	280.5	326.3	70	49	138.9	148.14	91.86	210.3	100.95	42.22			219.4		85.80
Averages		7.38	13.48	89.61	54.72	9.67	9.89	70	49	3.47	3.80	91.86	5.13	2.52	49.22			6.67		3.58
Minima		6.6	12.5	85.5	51.0	8.9	9.2	66	49	3.17	3.5	86.0	4.6	2.3	49.2			5.9		3.1
Maxima		8.4	14.3	103.0	62.2	10.6	10.7	74	63	3.75	4.13	98.7	5.75	2.75	53.2			7.55		4.35

[1] Near.

BASKET-MAKERS—Continued

SOUTHEASTERN UTAH, ROCKSHELTERS, CRANIA—Continued

FEMALE

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximam)	Diam. lateral maxim.	Basion-Bregma height	Cranial Index	Mean height Index	Height-Breadth Index	Cranial Module	Capacity, in c. c. (Pearson's method)	Teeth, wear	Menton-Nasion height (a)
282	A. M. N. H. (Hyde Expedition).	Grand Gulch Region	Adult		17.6	12.3	12.5	69.9	82.6	101.6	14.13	1,169	Moderate	10.9
307	do	do	do		17.6	12.4	12.8	70.5	85.8	103.2	14.27	1,220	Considerable	11.9
116a	do	do	do		17.5	12.4	12.9	70.9	86.3	104.0	14.27	1,210	do	[1] 13.1
266a	do	do	do		17.2	12.4	13.0	72.1	87.8	104.8	14.20	1,170		
790	do	do	do		17.4	12.6	12.8	72.4	85.5	101.6	14.27	1,220		
658	do	do	do		17.2	12.5	12.9	72.7	86.9	103.2	14.20	1,135		11.2
1010	do	do	do		17.2	12.6	12.2	73.3	81.9	96.8	14.00	1,115		
534	do	do	do		17.4	12.9	13.2	74.1	84.4	102.3	14.50	1,280	No wear	11.3
113a	do	do	do		17.2	12.8	12.6	74.4	80.0	98.8	14.09	1,105		11.3
412	do	do	do		16.9	12.6	13.0	74.6	88.1	103.2	14.17	1,230		11.1
321	do	do	do		17.2	13.0	13.0	75.6	86.1	100.0	14.40	1,230	Considerable	[1] 11.9
103	do	do	do		16.8	12.7	12.8	75.6	86.8	100.8	14.19	1,235		11.3
i	do	do	do		17.4	13.2	12.7	75.9	83.0	98.2	14.43			
308	do	do	do		16.9	13.0	12.8	76.9	85.6	98.5	14.25			
635	do	do	do		17.7	13.7	12.8	77.4	81.5	93.4	14.73		No wear	
516	do	do	do		16.4	12.7	12.2	77.4	84.9	96.1	13.77	1,050	All lost	
326	do	do	do		16.6	12.9	12.7	77.7	86.1	98.5	14.07	1,125		
408	do	do	do		16.4	12.8	12.4	78.0	84.9	96.9	13.87	1,160		10.4
503	do	do	do		16.7	13.2	12.6	79.0	84.5	95.5	14.17	1,180	Considerable	10.6
511	do	do	do		16.7	13.5	12.7	80.8	84.1	94.1	14.30	1,169		
552	do	do	do	Atypical	(16.2)	(13.6)	(12.2)	(84.0)	(81.9)	(89.7)	14.09	1,160		11.6
d	do	do	do	Slight occipital	(15.5)	(13.8)		(89.0)						
8	do	do	do	Marked occipital	(15.1)	(14.2)	(13.6)	(94.0)	(92.8)	(95.8)	14.30			
b	do	do	do	do	(15.4)	(14.5)	(13.8)	(94.2)	(92.3)	(95.2)	14.57	1,175		10.8
244	do	do	do		17.4		12.7							
109	do	do	do	Occipital compression										
Number of skulls					(21)	(20)	(21)	(20)	(20)	(20)	(23)	(19)		(13)
Totals					359.4	256.2	266.7				326.95	22,320		147.4
Averages					*17.11*	*12.81*	*12.70*	*74.91*	*84.92*	*99.14*	*14.22*	*1,175*		*11.24*
Minima					16.4	12.3	12.0	*69.9*	*80.0*	*93.4*	13.77	1,050		10.4
Maxima					17.7	13.7	13.2	*89.8*	*88.1*	*104.8*	14.73	1,280		13.1

Catalogue No.	Alveol. Pt.-Nasion Height (b)	Diam. Bizygomatic maxim. (c)	Facial Index, total $\left(\frac{a \times 100}{c}\right)$	Facial Index, upper $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, Mean	Orbits—Breadth, Mean	Orbital Index, Mean	Nose, height	Nose, breadth maxim.	Nasal Index	Upper Alveolar Arch, Length maxim.	Upper Alveolar Arch, Breadth maxim.	Upper Alveolar Arch Index	Lower Jaw, height of Symphysis
282	6.7	12.3	88.6	54.5	9.1	8.0	9.4	71	53	3.4	3.8	89.5	4.7	2.35	50.0		5.6		3.6
307	7.3	13.0	91.5	56.2	9.3	8.2	9.8	71	55	3.4	3.75	90.7	5.1	2.4	47.1		6.3		3.7
116a	7.1	12.7	103.2	55.9	9.3	8.0	9.5	69	52	3.4	3.75	90.7	4.7	2.5	53.2		6.25		
266a	6.9	12.7	94.3	54.3	9.0	7.9	9.1	68	55	3.25	3.65	89.0	4.6	2.5	54.3		6.9		
790							9.8												3.5
638	6.7	12.0	93.3	55.8	9.8	8.6	9.5	67	50	3.15	3.47	90.8	4.65	2.5	53.8		6.3		
1010	6.6	11.8		56.9	9.7	8.6	9.5	68	53	3.22	3.92	82.1	4.6	2.6	56.5		6.2		3.85
534	6.9	13.6	83.1	50.7	10.4	9.0	10.0	67	49	3.37	3.6	93.6	4.7	2.5	53.2		6.95		3.15
113a	6.7	12.3	91.9	54.5	9.0	8.2	9.1	69	60	3.1	3.67	84.5	4.8	2.6	54.2		6.4		3.2
412	7.0	12.6	88.1	55.6	9.8	8.4	9.9	70	48	3.2	3.65	87.7	4.95	2.6	52.5		6.8		
321	7.0	12.1	93.4	57.8	9.4	8.1	9.4	68	51	3.3	3.6	91.7	4.8	2.3	47.9				
103	7.1	12.2	92.6	58.2	8.7	7.5	9.0	69	54	3.45	3.72	92.7	4.8	2.55	53.1		6.4		3.3
i	7.0	13.1	53.4	53.4	9.0	7.8	9.0	68		3.5	3.9	89.7							
308		12.8					8.8												
635	6.7	12.7		52.8	9.1	8.2	9.2	70	58	3.35	3.95	84.8	4.75	2.6	54.7		6.45		
516		12.5			10.0	8.1	9.0			3.45	3.85	89.6	4.7	2.65	56.4				3.1
325	6.8					8.8	9.7	68	52	(3.0)	3.72	(80.7)	4.75	2.6	54.7				
408	6.1	11.9	87.4	51.3	8.8	7.8	9.1	73	54	2.97	3.4	87.4	4.35	2.2	50.6		5.9		2.9
503	6.7	12.6	84.1	53.2	9.8	8.7	9.6	69	55	3.27	3.9	83.9	4.65	2.45	52.7				3.45
511	7.1	12.9		55.0	1(9.0)	7.8	9.5	(72)	(52)	3.6	3.78	95.2	5.05	2.4	47.5		1 6.0		3.35
552	6.8	13.0	89.2	52.3	9.5	8.4	9.2	67	53	3.22	3.7	87.0	4.85	2.5	51.5		(6.65)		3.75
d	6.6	12.3		53.7						3.42	3.47	98.6	4.8	2.2	46.8		6.1		
8							9.6												
b	6.4	12.9	83.7	49.6	9.2	8.2	9.4	72	55	3.25	3.72	87.9	4.55	2.2	48.3		6.1		3.15
244	7.0																		
100	7.2				9.5	8.3	9.4	68	51	3.5	3.65	95.9	4.95	2.4	48.6		6.55		
										3.45	3.8	90.8	5.5	2.55	46.3				
Number of skulls	(22)	(21)	(19)	(19)	(19)	(21)	(24)	(19)	(18)	(22)	(23)	(22)	(22)	(22)	(22)		(16)		(13)
Totals	150.4	264.0			178.4	172.6	225.5			71.24	85.42		105.3	54.15			101.2		44.0
Averages	6.84	12.57	90.32	54.21	9.39	8.22	9.40	69	53	3.38	3.71	90.87	4.79	2.46	51.43		6.33		3.39
Minimum	6.1	11.8	83.1	49.6	8.7	7.5	8.8	67	48	2.97	3.4	82.1	4.35	2.2	47.5		5.6		2.9
Maximum	7.3	13.6	103.2	58.2	10.4	9.0	10.0	73	60	3.6	3.95	98.6	5.5	2.65	56.5		6.95		3.85

[1] Near.

NAVAHO

NEW MEXICO CRANIA

MALE

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. anteroposterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. Pt.-Nasion height (b)
243784	A. M. M.	New Mexico [1]	60		[2] 19.2	13.7	14.8	*71.4*	*90.0*	*108.0*	15.90	1,715	Considerable		7.7
243780	do	do	30		18.1	13.7	14.1	*74.5*	*87.9*	*102.9*	15.40	1,510	Slight		
225079	do	Fort McRae	25		17.1	13.0	13.8	*74.7*	*90.8*	*106.2*	14.73	1,345	No wear	11.2	6.9
243499	do	Near Fort Defiance	35		18.6	14.1	14.4	*75.8*	*88.1*	*102.1*	15.70	1,620	Slight	13.0	7.7
334051	N. M. Judd, N. G. S.	Near Pueblo Bonito	50		16.6	14.4	13.5	*86.8*	*87.1*	*93.8*	14.83	1,375	Medium	12.0	7.5
243782	A. M. M.	Near Fort Summer	60	Slight	17.2	15.3	14.0	*89.0*	*86.2*	*91.5*	15.50	1,515	Moderate		7.9
Number of skulls					(6)	(6)	(6)	*(6)*	(6)	*(6)*	(6)	(6)		(3)	(5)
Totals					107.4	84.2	84.6				92.06	9,080		36.2	37.7
Averages					*17.90*	*14.03*	*14.10*	*78.40*	*88.51*	*100.42*	*15.34*	*1,513*		*12.07*	*7.54*

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion-Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, Right	Orbits—Height, Left	Orbits—Breadth, Right	Orbits—Breadth, Left	*Orbital Index, Right*	*Orbital Index, Left*	Nose, Height	Nose, Breadth maxim.	*Nasal Index*	Upper Alveolar Arch, Length maxim.	Upper Alveolar Arch, Breadth maxim.	*Alveolar Arch, Index*	Lower Jaw, Height at Symphysis
243784	14.8		*52.0*	10.2	9.2	11.5	° 79	° 59		3.75		4.1		*91.5*	5.5	2.65	*48.2*				3.65
243780						10.2															
225079	12.5	*89.6*	*55.2*	9.8	9.0	10.2	73	62	3.3	3.3	3.85	3.8	*85.7*	*86.8*	4.95	2.35	*47.5*	5.4	6.2	*87.1*	3.2
243499	14.3	*90.9*	*53.8*	9.4	8.2	10.2	73	56	3.7	3.7	4.0	4.0	*92.5*	*92.5*	5.2	2.5	*48.1*	5.4	[2] 6.7	*80.6*	4.1
334051	14.2	*84.5*	*52.8*	9.5	8.4	10.0	71	57	3.5	3.5	3.7	3.7	*94.6*	*94.6*	5.1	2.55	*50.0*	5.5	6.3	*87.3*	3.3
243782	13.9		*56.8*	10.1	8.4	10.1	67	48	3.7	3.7	3.9	3.9	*94.9*	*94.9*	5.15	2.4	*46.6*	5.8	6.6	*87.9*	
Number of skulls	(5)	(3)	(5)	(5)	(5)	(6)	(5)	(5)	(4)	(5)	(4)	(5)	(4)	(5)	(5)	(5)	(5)	(4)	(4)	(4)	(4)
Totals	69.7			49.0	43.2	62.2			14.20	17.95	15.45	19.50			25.9	12.45		22.1	25.8		14.25
Averages	*13.94*	*88.29*	*54.08*	*9.8*	*8.64*	*10.37*	*72*	*56*	*3.55*	*3.59*	*3.86*	*3.90*	*91.91*	*92.05*	*5.18*	*2.49*	*48.07*	*5.58*	*6.45*	*87.66*	*3.56*

[1] Exact locality not known.

[2] Near.

NAVAHO—Continued

NEW MEXICO CRANIA—APACHE-LIKE

MALE

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. anteroposterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, wear	Menton-Nasion height (a)	Alveol. P.-Nasion height (b)
226005	A. M. M.	New Mexico [1]	30		18.1	14.7	13.3	*81.2*	*81.1*	*90.5*	15.37	1,515	No wear	[2] 12.8	7.8

Catalogue No.	Diam. Bizygomatic maxim. (c)	*Facial Index, total* $\left(\frac{a \times 100}{c}\right)$	*Facial Index, upper* $\left(\frac{b \times 100}{c}\right)$	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle	Alveolar Angle	Orbits—Height, Right	Orbits—Height, Left	Orbits—Breadth, Right	Orbits—Breadth, Left	*Orbital Index, Right*	*Orbital Index, Left*	Nose, Height	Nose, Breadth maxim.	*Nasal Index*	Upper Alveolar Arch, Length maxim.	Upper Alveolar Arch, Breadth maxim.	*Upper Alveolar Arch, Index*	Lower Jaw, Height at Symphysis
226005	14.2	*90.1*	*54.9*	10.5	9.4	10.8	71	58	3.35	3.4	3.95	3.95	*84.8*	*86.1*	5.35	2.8	*52.3*	5.9	6.9	*85.5*	3.9

[1] Exact locality not known.
[2] Near.

NAVAHO—Continued

NEW MEXICO CRANIA

FEMALE

Catalogue No.	Collection	Locality	Approximate age of subject	Deformation	Diam. antero-posterior maxim. (glabella ad maximum)	Diam. lateral maxim.	Basion-Bregma height	*Cranial Index*	*Mean Height Index*	*Height-Breadth Index*	Cranial Module	Capacity, in c. c. (Hrdlička's method)	Teeth, Wear	Menton-Nasion height (a)	Alveol. Pt. Nasion height (b)
228017	A. M. M.		35		17.4	13.2	13.3	*75.9*	*86.9*	*100.8*	14.63	1,265	Slight to moderate.	11.6	7.4
243779	do	Bosgne Rodondo Reservation	22		17.7	13.9	12.6	*78.5*	*79.8*	*90.7*	14.73	1,390	No wear		7.2
243505	do	Near Fort Defiance	40		17.9	14.4	13.4	*80.5*	*83.0*	*93.1*	15.23	1,500	Moderate		7.5
243783	do	Near Fort Summer	35		17.4	14.2	13.6	*81.6*	*86.1*	*95.8*	15.07	1,325	Slight	11.5	7.3
243504	do	Near Fort Defiance	50		16.8	13.9	13.6	*82.7*	*88.6*	*97.8*	14.77	1,280			7.4
225080	do	Fort Wingate	70		17.2	14.3	14.0	*83.1*	*88.9*	*97.9*	15.17	1,300	Considerable		[2] 7.2
225078	do	Near Fort Summer	55	Slight	16.2	13.6	13.3	*84.0*	*89.3*	*97.8*	14.37	1,215	do	[2] 11.2	6.9
225077	do	Near Fort Union	30		16.4	13.8	12.3	*84.2*	*81.5*	*89.1*	14.17	1,205	Very slight	10.6	6.6
243778	do	Bosgne Rodondo Reservation	40		16.9	14.3	13.3	*84.6*	*85.3*	*93.0*	14.83	1,380	Slight		[2] 7.1
243497	do	Fort Wingate	40		16.7	14.3	12.7	*85.6*	*81.9*	*88.8*	14.57	1,425	do	11.6	7.2
243781	do	Near Fort Summer	60		17.1	15.0		*87.7*				1,530	All lost		[2] 7.2
Number of skulls					(11)	(11)	(10)	*(11)*	*(10)*	*(10)*	(10)	(11)		(5)	(11)
Totals					187.7	154.9	132.1				147.54	14,815		56.5	79.0
Averages					*17.06*	*14.08*	*13.21*	*82.52*	*85.09*	*94.42*	*14.75*	*1,347*		*11.3*	*7.18*
Minima					16.2	13.2	12.3	*75.9*	*79.8*	*88.8*	14.17	1,205		10.6	6.6
Maxima					17.9	15.0	14.0	*87.7*	*89.3*	*100.8*	15.23	1,530		11.6	7.5

Catalogue No.	Diam. Bizygomatic maxim. (c)	Facial Index, total (a×100)/c	Facial Index, upper (b×100)/c	Basion-Alveolar Pt.	Basion Subnasal Pt.	Basion-Nasion	Facial Angle °	Alveolar Angle °	Orbits—Height, right	Orbits—Height, left	Orbits—Breadth, right	Orbits—Breadth, left	Orbital Index, right	Orbital Index, left	Nose, height	Nose, breadth maxim	Nasal Index	Upper Alveolar Arch, length maxim.	Upper Alveolar Arch, breadth maxim.	Upper Alveolar Arch, Index	Lower Jaw, Height at Simphysis
228017	13.1	88.6	56.5	10.2	9.0	10.2	69	54	3.2	3.3	3.85	3.75	83.1	88.0	5.1	2.55	50.0	5.4	6.4	84.4	3.4
243779	12.9		55.8	9.7	8.6	9.9	70	53							5.2	2.6	50.0	5.4	6.3	85.7	
243505	13.5		56.6	10.2	8.8	10.0	67	53	3.5	3.4	3.95	4.0	88.6	85.0	4.9	2.7	55.1	5.8	6.7	86.6	
243783	13.5	85.2	54.1	9.6	8.4	9.9	70	51	3.4	3.4	3.8	3.7	89.5	91.9	5.25	2.8	53.3	5.2	6.3	82.5	3.25
243504	13.6		54.4	9.9	8.6	10.0	69	51	3.4	3.5	3.8	3.9	89.5	89.7	5.2	2.8	53.9	5.6	6.8	82.4	
225080	13.6		52.9		8.2	9.9			3.4	3.4	3.9	3.8	87.2	87.2	5.15	2.7	52.4				3.6
225078	13.1	85.5	52.7	9.0	8.2	9.7	74	61	3.25	3.35	3.9	3.8	83.3	88.2	5.0	2.6	52.0	5.0	6.3	79.4	3.4
225077	12.8	82.8	51.6	9.2	8.0	9.0	67	48	3.25	3.3	3.6	3.65	90.8	90.4	4.8	2.35	49.0	5.2	6.2	83.9	3.0
243778	12.9		55.0		8.4	9.9			3.5	3.4	3.65	3.65	95.9	93.2	5.1	2.3	46.1				
243497	13.1	88.6	56.0	9.4	8.4	9.2	66	56	3.6	3.6	3.9	3.9	92.3	92.3	5.2	2.5	48.1	5.0	6.1	82.0	3.6
243781	13.8		52.2						3.5	3.45	3.8	3.8	92.1	90.8	5.15	2.5	48.5				2.9
Number of skulls	(11)	(5)	(11)	(8)	(10)	(10)	(8)	(8)	(10)	(10)	(10)	(10)	(10)	(10)	(11)	(11)	(11)	(8)	(8)	(8)	(7)
Totals	145.9			77.2	84.6	97.7			34.1	38.05	38.15	38.05	89.13	89.62	56.05	28.4		42.6	51.1		23.15
Averages	*13.26*	*86.13*	*54.15*	*9.65*	*8.46*	*9.77*	*69*	*53*	*3.41*	*3.81*	*3.82*	*3.81*	*83.1*	*85.0*	*5.10*	*2.58*	*50.67*	*5.33*	*6.39*	*83.87*	*3.31*
Minima	12.8	82.8	51.6	8.0	8.0	9.0	66	48	3.2	3.3	3.6	3.65	83.1	85.0	4.8	2.3	46.1	5.0	6.1	79.4	2.9
Maxima	13.8	88.6	56.5	10.2	9.0	10.2	74	61	3.6	3.6	3.95	4.0	95.9	93.2	5.25	2.8	55.1	5.8	6.8	86.6	3.6

[2] Near.

GENERAL COMPARISONS

CRANIAL INDICES IN UNDEFORMED SKULLS

	Males						Females					
	Cranial Index		Mean Height Index H: Mean of L+B		Height-Breadth Index $\frac{H \times 100}{B}$		Cranial Index		Mean Height Index		Height-Breadth Index	
	Specimens	Means	Specimens	Means	Specimens	Means	Specimens	Means	Specimens	Means	Specimens	Means
Southern Utah	(33)	73.0	(30)	85.4	(30)	101.3	(20)	74.9	(20)	84.9	(20)	99.1
Dolichocranic, New Mexico	(3)	73.3	(3)	85.0	(3)	100.5	(5)	72.4	(3)	84.2	(3)	98.9
Salt River	(2)	75.4					(4)	76.5	(4)	88.5	(4)	102.1
Old Zuñi (Havikuh)	(34)	75.9	(30)	86.4	(30)	100.1	(51)	80.1	(48)	86.5	(48)	97.1
Mesocranic, New Mexico	(3)	77.8	(3)	85.9	(3)	98.1						
Téwa, Kwasteyukwa	(3)	79.1	(2)	88.0	(3)	102.2	(3) (2)	78.8 85.6	(3)	85.7	(3)	97.2
Téwa, Giusiwa	(2)	79.5	(3)	87.3	(3)	98.5						
Téwa, Otowi	(3)	79.9	(2)	84.8	(2)	96.0						
Téwa, Puyé	(6)	83.8	(6)	89.1	(6)	97.7	(3)	83.6	(3)	86.2	(3)	94.6
Miscellaneous, Arizona	(3)	84.1	(2)	88.2	(2)	96.8	(6)	77.8 81.1	(4)	85.9	(4)	95.9
Brachyranic, New Mexico	(3)	84.4	(3)	89.6	(3)	97.9	(5)	87.9	(2)	86.8	(2)	94.2

FACIAL INDICES IN UNDEFORMED SKULLS

	Males				Females			
	Facial Index Total		Facial Index Upper		Facial Index Total		Facial Index Upper	
	Specimens	Means	Specimens	Means	Specimens	Means	Specimens	Means
Southern Utah	(21)	89.6	(32)	54.7	(13)	90.3	(19)	54.2
Dolichocranic			(2)	53.9	(2)	87.5	(2)	53.3
Salt River							(3)	54.3
Old Zuñi	(28)	90.5	(30)	54.3	(35)	89.2	(39)	53.6
Mesocranic								
Téwa, Kwasteyukwa	(3)	88.4	(3)	53.2				
Téwa, Giusiwa	(2)	84.1	(2)	50.7				
Téwa, Otowi			(2)	52.0				
Téwa, Puyé	(3)	(82.8)	(3)	(49.8)			(2)	50.9
Brachycranic, New Mexico	(3)	82.1	(3)	51.2			(2)	55.1
Miscellaneous, Arizona			(2)	57.5			(3)	57.0

FACIAL INDICES IN DEFORMED SKULLS

New Mexico:								
Téwa	(7)	88.2	(8)	52.3	(18)	86.1	(24)	52.9
Puyé	(10)	85.7	(12)	52.9	(14)	88.1	(15)	53.7
Chaco Cañon	(5)	90.6	(7)	53.4				
Old Zuñi	(8)	88.1	(8)	53.0	(8)	86.9	(7)	52.7
Miscellaneous	(4)	86.9	(7)	52.2	(6)	84.8	(6)	52.7
Arizona:								
Salt River	(12)	88.1	(31)	55.5	(13)	89.2	(37)	54.3
Old Hopi			(4)	56.2			(2)	54.6
Elden	(3)	88.1	(3)	53.5	(3)	93.8	(4)	56.0
Chaves Pass			(6)	54.9			(10)	54.3
Petrified Forest	(7)	90.1	(8)	54.3	(3)	87.3	(3)	53.5
Miscellaneous	(8)	89.3	(15)	54.6	(18)	89.8	(26)	54.6

GENERAL COMPARISONS—Continued

ORBITAL, NASAL, AND DENTAL ARCH INDICES IN UNDEFORMED SKULLS

	Males						Females					
	Mean Orbital Index		Nasal Index		Dental Arch Index		Mean Orbital Index		Nasal Index		Dental Arch Index	
	Specimens	Means	Specimens	Means	Specimens	Means	Specimens	Means	Specimens	Means	Specimens	Means
Southern Utah	(39)	91.3	(40)	49.2			(22)	90.9	(22)	51.4		
Dolichocranic, New Mexico	(3)	88.9	(3)	49.7			(3)	(96.2)	(3)	51.0	(3)	86.4
Salt River							(4)	89.9	(4)	52.6	(3)	81.6
Old Zuñi	(30)	92.3	(32)	49.3	(27)	83.8	(44)	93.7	(44)	52.7	(38)	85.1
Mesocranic, New Mexico	(3)	89.9	(3)	49.0	(3)	81.2						
Kwasteyukwa	(3)	92.5	(3)	51.2	(3)	82.8	(3)	91.6	(3)	50.7		
Giusiwa	(2)	89.2	(3)	52.8	(2)	84.2						
Otowi	(3)	96.8	(2)	52.4	(2)	82.3						
Puyé	(4)	92.0	(5)	52.5	(4)	83.4	(2)	89.5	(2)	53.2		
Brachycranic, New Mexico	(3)	(85.8)	(3)	50.3	(3)	86.7	(2)	92.6	(2)	52.8		
Miscellaneous, Arizona	(4)	92.0	(4)	49.8	(2)	85.0	(5)	95.4	(4)	50.8	(2)	84.3

ORBITAL, NASAL, AND DENTAL ARCH INDICES IN DEFORMED SKULLS

Colorado	(3)	86.8	(3)	50.0								
New Mexico:												
Téwa (excluding Puyé)	(14)	90.5	(16)	52.8	(13)	85.9	(26)	93.0	(30)	52.1	(26)	85.1
Puyé	(15)	90.9	(17)	48.6	(11)	84.0	(19)	92.8	(27)	51.9	(21)	86.0
Chaco Cañon	(8)	91.4	(11)	48.6	(7)	81.5	(6)	89.2	(6)	50.7		
Old Zuñi	(11)	92.1	(12)	49.5	(8)	83.1	(16)	89.9	(15)	53.1	(14)	82.4
Miscellaneous	(9)	89.8	(9)	51.6	(6)	85.4	(8)	91.5	(8)	51.1	(6)	82.9
Arizona:												
Salt River	(48)	91.6	(51)	48.4	(32)	82.0	(55)	91.9	(53)	51.2	(39)	85.2
Old Hopi	(5)	89.9	(5)	49.7	(4)	85.9	(5)	96.6	(3)	50.9		
Elden	(6)	89.3	(7)	50.9	(4)	81.5	(6)	94.2	(6)	49.3	(5)	79.9
Chaves Pass	(15)	92.1	(16)	47.4	(10)	84.8	(15)	90.6	(15)	50.2	(11)	84.0
Petrified Forest	(10)	93.8	(12)	48.0	(12)	82.4	(5)	91.8	(5)	52.2	(5)	83.1
Miscellaneous	(30)	90.9	(33)	49.6	(27)	83.7	(38)	91.2	(37)	51.0	(27)	85.7

FACIAL ANGLES IN UNDEFORMED SKULLS

	Males				Females			
	Facial Angle		Alveolar Angle		Facial Angle		Alveolar Angle	
	Specimens	Means	Specimens	Means	Specimens	Means	Specimens	Means
Southern Utah	(29)	70	(28)	55	(19)	69	(18)	53
Dolichocranic, New Mexico					(2)	67		
Salt River					(4)	71		
Old Zuñi	(23)	70	(23)	52	(39)	69	(39)	51
Mesocranic, New Mexico	(3)	69	(3)	53				
Téwa, Kwasteyukwa	(3)	69.5	(3)	50	(2)	68	(2)	50
Téwa, Giusiwa	(2)	68	(2)	48.5				
Téwa, Otowi	(2)	67.5	(2)	45.5				
Téwa, Puyé	(5)	72	(5)	54	(2)	68	(2)	44
Brachycranic, New Mexico	(3)	69.5	(3)	48.5	(2)	65.5	(2)	43.5
Miscellaneous, Arizona	(2)	69	(2)	49.5				

FACIAL ANGLES IN DEFORMED SKULLS

Colorado	(2)	71	(2)	53				
New Mexico:								
Téwa	(11)	68	(11)	49.5	(24)	69	(23)	51
Puyé	(9)	69	(9)	56	(16)	69	(16)	52
Chaco Cañon	(8)	73	(8)	57	(3)	74	(3)	57
Old Zuñi	(8)	69	(8)	54	(11)	69	(10)	51
Miscellaneous	(3)	71	(3)	54	(7)	71	(7)	52
Arizona:								
Salt River	(10)	71			(26)	70		
Old Hopi								
Elden	(3)	69	(3)	51				
Chaves Pass	(9)	69	(9)	52	(12)	69	(12)	52
Petrified Forest	(8)	70	(8)	51	(4)	69	(4)	48
Miscellaneous	(16)	69	(16)	52	(24)	70	(24)	49

GENERAL COMPARISONS—Continued

CRANIAL MODULE AND CRANIAL CAPACITY IN UNDEFORMED SKULLS

	Males				Females			
	Module (Mean Diam.), cm.		Capacity, c. c.		Module (Mean Diam.), cm.		Capacity, c. c.	
	Specimens	Means	Specimens	Means	Specimens	Means	Specimens	Means
Southern Utah	(33)	14.86	(31)	1,342	(23)	14.22	(19)	1,175
Dolichocranic, New Mexico	(3)	14.93	(3)	1,388	(3)	14.21	(4)	1,204
Salt River					(4)	14.39	(4)	1,214
Old Zuñi	(30)	14.76	(27)	1,305	(50)	14.09	(43)	1,166
Mesocranic, New Mexico	(3)	15.06	(3)	1,385				
Kwasteyukwa	(2)	15.00	(2)	1,330	(3)	14.22		
Giusiwa	(3)	14.81	(3)	1,367				
Otowi								
Puyé	(4)	14.86	(4)	1,344	(3)	14.28	(3)	1,223
Brachycranic, New Mexico	(3)	15.04	(3)	1,325	(2)	14.15		
Miscellaneous, Arizona	(2)	14.82	(2)	1,312	(4)	14.17	(3)	1,210

CRANIAL MODULE AND CRANIAL CAPACITY IN DEFORMED SKULLS

New Mexico:								
Têwa	(13)	15.00	(12)	1,363	(27)	14.35	(23)	1,225
Puyé	(15)	14.86	(13)	1,347	(26)	14.13	(23)	1,188
Chaco Canyon	(7)	15.21	(9)	1,359	(6)	14.74	(6)	1,280
Old Zuñi	(10)	14.72	(10)	1,331	(13)	14.29	(14)	1,199
Miscellaneous	(7)	15.15	(7)	1,406	(7)	14.52	(6)	1,267
Arizona:								
Salt River	(32)	15.25	(29)	1,399	(43)	14.55	(42)	1,231
Old Hopi	(2)	14.90	(3)	1,383	(2)	14.80	(3)	1,245
Elden	(5)	15.25	(7)	1,446	(3)	14.60	(3)	1,317
Chaves Pass	(15)	15.13	(13)	1,423	(15)	14.36	(15)	1,237
Petrified Forest	(11)	15.01	(11)	1,401	(6)	14.51	(5)	1,274
Miscellaneous	(22)	14.94	(24)	1,380	(35)	14.47	(31)	1,253

PUEBLO INDIANS: CEPHALIC INDEX

UNDEFORMED HEADS

Pueblos	Number of subjects measured	Average Cephalic Index *cm.*	Pueblos	Number of subjects measured	Average Cephalic Index, *cm.*
MALES			MALES—continued		
Taos	37	*78.2*	Zuñi	49	*81.8*
Sia	(3)	*(78.5)*	Hopi	64	*83.0*
Sto. Domingo	30	*79.6*			
San Juan	16	*80.2*	FEMALES		
Jemez	25	*80.3*			
Laguna	46	*80.3*	Laguna	27	*81.2*
Acoma	(4)	*(81.2)*	Hopi	22	*82.5*
Isleta	21	*81.2*	Zuñi	31	*82.3*
Hano	11	*81.4*	Hano	6	*84.0*

NAVAHO

UNDEFORMED [1]

Pueblos	Number of subjects measured	Average Cephalic Index, *cm.*
Males	28	83.7
Females	27	84.3

[1] Nearly one-half of the Navaho showed a perceptible to marked deformation of the Pueblo type (occipital compression). As with the skulls, the heads are *high*.

SUMMARY OF RESULTS AND INDICATIONS

The main results and indications of the data here given are as follows:

1. The Pueblos are not one homogeneous group. They differ in head form and in other respects. There are two distinct strains in them, with intermediary elements.

2. The undeformed skulls show on one hand a substantial dolichoid and on the other a fairly strong brachycranic group, with some intermediate units.

3. The predominant dolichoid group comprised the southern Utah cave dwellers, the majority of the old Zuñi (Havikuh), the Salt River people, and elements among the Rio Grande as well as other Pueblos; the less numerous brachycranics were the Puyé in New Mexico, the Hopi in Arizona, and some others. The best defined intermediates were the majority of the Téwas of the Jemez region. In many of the old Pueblos the prevalent type of the skull is difficult to ascertain due to the frequency and extent of deformations.

4. The geographical distribution of the dolichoid and the brachycranic elements was irregular and there was evidently considerable interpenetration.

5. The Puyé group on morphological grounds stands distinctly apart from the rest of the Téwa and can not be inherently associated with the latter.

TÉWA AND PUYÉ

	Cranial Index	Mean Height Index	Height-Breadth Index		Cranial Index	Mean Height Index	Height-Breadth Index
MALES				FEMALES			
Téwa excluding Puyé	79.5	86.8	99.3	Téwa excluding Puyé	78.8	85.7	97.2
Puyé	83.8	89.1	97.7	Puyé	83.6	86.2	94.6

6. The Grand Gulch (southern Utah) cave dwellers or "basket makers," are a remarkably uniform lot. Barring a small percentage of deformed skulls the series shows but one and the same type, subdivisions of which are not possible. There is no indication in either this or the available Pueblo material of anything that would correspond physically to the lately adopted multiple archeological subdivisions relating to the same groups.

7. The southern Utah basket maker crania are practically identical with the apparently intrusive skulls of the Téwa region; and are

closely related with the crania of the Salt River Valley and of the old Zuñi (Havikuh village):

	Cranial Index	Mean Height Index	Height-Breadth Index	Facial Index, Upper	Orbital Index	Nasal Index	Cranial Module	Cranial Capacity
MALES								
Southern Utah	73.0	85.4	101.3	54.7	91.3	49.2	14.86	1,342
Dolichocranic, New Mexico	73.3	85.0	100.5	53.9	88.9	49.7	14.93	1,388
FEMALES								
Southern Utah	74.9	84.9	99.1	54.2	----	51.4	14.22	1,175
Dolichocranic, New Mexico	72.4	84.2	98.9	53.3	----	51.0	14.21	1,204

8. The mesocranic Téwa are quite likely the result of a mixture of the brachy-Puyé with the dolicho-Pueblo elements. They are in general closely related to both and have no earmarks of anything distinct.

9. The deformed skulls, after elimination of the infrequent cases where the base and face were obviously affected by the distortion, show but little if any disturbances of the facial indices or angles, or of the size of the skull. The moderately deformed skull is therefore, after all, of some anthropometric value.

Comparison of deformed with undeformed

	Males				Females			
	Facial Index, total		Facial Index, upper		Facial Index, total		Facial Index, upper	
	In undeformed	In deformed	In undeformed	In deformed	In undeformed	In deformed	In undeformed	In deformed
Puyé:								
Specimens	(3)	(10)	(3)	(12)	----	----	----	----
Means	82.8	85.7	49.8	52.9	----	----	----	----
Other Téwa:								
Specimens	(5)	(7)	(7)	(8)	----	----	----	----
Means	86.7	88.2	52.1	52.3	----	----	----	----
Old Zuñi:								
Specimens	(28)	(8)	(30)	(8)	(35)	(8)	(39)	(7)
Means	90.5	88.1	54.3	53.0	89.2	86.9	53.6	52.7

	Males						Females					
	Orbital Index		Nasal Index		Dental Arch Index		Orbital Index		Nasal Index		Dental Arch Index	
	Undeformed	Deformed	Undeformed	Deformed	Undeformed	Deformed	Undeformed	Deformed	Undeformed	Deformed	Undeformed	Deformed
Puyé:												
Specimens	(4)	(15)	(5)	(17)	(4)	(11)	(2)	(19)	(2)	(27)	----	----
Means	92.0	90.9	52.5	48.6	83.4	84.0	89.5	92.8	53.2	51.9	----	----
Other Téwa:												
Specimens	(8)	(14)	(8)	(16)	(7)	(13)	(3)	(26)	(3)	(30)	----	----
Means	95.3	90.5	52.2	52.8	83.0	85.9	91.6	93.0	50.7	52.1	----	----
Old Zuñi:												
Specimens	(30)	(11)	(32)	(12)	(27)	(8)	(44)	(16)	(44)	(15)	38)	(14)
Means	92.3	92.1	49.3	49.5	83.8	83.1	93.7	89.9	52.7	53.1	85.1	82.4

Comparison of deformed with undeformed—Continued

	Males				Females			
	Facial Angle		Alveolar Angle		Facial Angle		Alveolar Angle	
	Undeformed	Deformed	Undeformed	Deformed	Undeformed	Deformed	Undeformed	Deformed
Puyé:								
Specimens	(5)	(9)	(5)	(9)				
Means	72	69	54	56				
Téwa (excluding Puyé):								
Specimens	(7)	(11)	(7)	(11)	(2)	(24)	(2)	(23)
Means	68.5	68	48.5	49.5	68	69	50	51
Old Zuñi:								
Specimens	(23)	(8)	(23)	(8)	(39)	(11)	(39)	(10)
Means	70	69	52	54	69	69	51	51

	Males				Females			
	Module		Capacity		Module		Capacity	
	Undeformed	Deformed	Undeformed	Deformed	Undeformed	Deformed	Undeformed	Deformed
Puyé:								
Specimens	(4)	(15)	(4)	(13)	(3)	(26)	(3)	(23)
Means	14.86	14.86	1,344	1,347	14.28	14.13	1,223	1,188
Other Téwa:								
Specimens	(5)	(13)	(5)	(12)	(3)	(27)		(23)
Means	14.89	15.00	1,349	1,363	14.22	14.35		1,225
Old Zuñi:								
Specimens	(30)	(10)	(27)	(10)	50)	(13)	(43)	(14)
Means	14.76	14.72	1,305	1,331	14.09	14.29	1,166	1,189

10. In general, the cranial capacity of the Pueblo skull and hence the size of the brain, does not appear favorable. This is especially true in some of the groups. This showing in part, but not entirely, is connected with the moderate stature of the people (m. average males, 163.7; females, 151.5 cm.; A. H.). The absolute measurements in general indicate that the Pueblos, or at least a majority of them, were a somewhat weakened group.

Cranial capacity in Pueblos and other Indians [1]

	Male, Group Means, c. c.	Female, Group Means, c. c.
Pueblos	1,305–1,388	1,166–1,223
Alaska and Athapascan tribes	1,425–1,610	1,300–1,385
Algonkin and related tribes	1,420–1,558	1,280–1,349
Siouan tribes	1,455–1,527	1,319–1,352
Shoshonean tribes	1,309–1,454	1,243–1,307
California tribes	1,372–1,473	1,167–1,305

[1] Data of Nos. I and II of the catalogue; very small groups not considered.

11. The affinities of the Pueblos are a matter of considerable interest to American anthropology. The present material, though not all that could be wished for, appears sufficient for some indications.

And these indications throw new, unexpected, light on the peoples of the pueblo region.

The following abstracts speak for themselves. In brief, the Pueblos are found to differ substantially from their neighbors to the northwest and west; but they approach very significantly on one hand the Algonkins, and on the other hand the Gulf types of further east. Just what this means must be left to future determination; what is certain is that such differences can not be fortuitous. The dolichoid Californians and Shoshoneans, practically one type, stand definitely apart from the dolichoid high-vaulted Pueblos in the decidedly lower height of the vault as well as that of the face; and in the same way the low-vaulted Apache, Hualapai, and Suppai, now settled in the pueblo region, stand apart from the high-vaulted brachycranic Pueblos. The dolichoid pueblo crania, in all their important relative dimensions, resemble the Algonkin, while the brachyoid Pueblo skulls are practically identical with the mound crania of Arkansas, Louisiana, and what is known as the Gulf-type region in general.

PUEBLOS (DOLICHOID), compared with Algonkins, Shoshoneans, and Californians

MALES

	Algonkins	Pueblos (Dolichoid Means of the averages of 4 groups)	Shoshone Tribes	Californians
Specimens	(285)	(72–123)	(20)	(183)
Vault:				
Cranial Index	75.0	74.4	75.3	77.3
Mean Height Index	85.8	85.6	80.2	81.4
Height-Breadth Index	101.1	100.6	93.1	94.0
Face:				
Upper Facial Index	52.7	54.6	52.2	52.3
Orbital Index	88.6	91.0	87.8	91.2
Nasal Index	49.1	49.15	48.7	47.7

Pueblos (Dolichoid) and Algonkins

MALES

	Southern Utah "Basket makers"	Dolichocranic Pueblo Tĕwa Region	Old Zuñi (Havikuh)	Salt River, Arizona	Algonkins (and Iroquois)
Specimens	(33)	(3)	(34)	(2)	(285)
Vault:					
Cranial Index	73.0	73.3	75.9	75.4	75.0
Mean Height Index	85.4	85.0	86.4	----------	85.8
Height-Breadth Index	101.3	100.5	100.1	----------	101.1
Face:					
Facial Index, upper	54.7	53.9	54.3	[1]55.5	52.7
Orbital Index	91.3	88.9	92.3	[1]91.6	88.6
Nasal Index	49.2	49.7	49.3	[1]48.4	49.1

[1] In 31–51 deformed skulls where face was not noticeably affected by the deformation.

Comparison of Pueblos (Brachyoid), with Arkansas, Louisiana, and Florida Crania

MALES

	Pueblos (Brachyoid) Undeformed			Arkansas Mounds[1]	Louisiana Mounds[1]	Florida Mounds[1]
	Puye	Brachycranic, New Mex.	Brachycranic, Arizona			
Specimens	(6)	(3)	(3)	(12)	(10)	(69)
Vault:						
Cranial Index	83.8	84.4	84.1	84.0	82.9	82.4
Mean Height Index	89.1	89.6	88.2	88.5	91.4	87.1
Height-Breadth Index	97.7	97.9	96.8	96.6	100.9	96.6
Face:						
Facial Index, upper	[2] 52.3	[3]	[3]	52.0	53.0	52.5
Orbital Index	[2] 91.1			92.0	[4] 89.4	90.2	[5] 89.8
Nasal Index	[2] 49.5	50.3	49.8	50.2	50.9	47.0

[1] From Hrdlička, A. Report on Skeletal remains from Arkansas and Louisiana. Journ. Acad. Nat. Sci. Phila., 1909, vol. 14, pp., 173–240; Anthropology of Florida. Fla. St. Hist. Soc., Deland, 1922, vol. 1; and newer data.

[2] 15–22 undeformed and deformed skulls in which face was not perceptibly affected.

[3] But 1 or 2 specimens in which the determination was possible.

[4] In 7 crania, after elimination of 3 decidedly exceptional.

[5] In 15 brachycranic specimens.

12. The Navaho, though speaking Athapaskan, are, as was indicated by the writer long before,[2] not Apache, but essentially Pueblo. They are a mixture evidently of various old pueblo elements, dolicho, as well as brachycranic, with traces of the Apache. It is merely one more of the many cases among the American tribes where the language and the physical make-up of the group have but little relation.

Pueblo, Navaho, and Apache

	Males					Females		
	Pueblos (Dolichoid); means of the averages of 4 groups	Navaho (Dolichoid)	Pueblos (Brachyoid)	Navaho (Brachyoid)	Apache	Pueblos (Brachyoid)	Navaho (Brachyoid)	Apache
Specimens	(72–123)	(4)	(19)	(2)	[6] (15)	(41)	(9)	(7)
Vault:								
Cranial Index	74.4	74.1	83.3	85.7	84.7	83.7	83.8	86.8
Mean Height Index	85.6	89.2	87.6	86.7	80.3	87.0	85.6	80.9
Height-Breadth Index	100.6	104.8	96.4	92.7	87.4	95.6	94.2	87.1
Face:								
Upper Facial Index	51.6	53.7	52.2	54.3	50.9	53.9	53.7	48.3
Orbital Index	91.0	90.1	92.7	91.7	91.5	93.9	89.8	90.1
Nasal Index	49.1	47.9	51.2	49.6	50.4	52.7	50.8	54.5

[6] From Catalogue, No. 1, 1924, p. 38.

[2] Physical and Physiological Observations on the Navaho. Amer. Anthrop., 1900, vol. 2, p. 339 et seq. Also, Physiological and Medical Observations among the Indians, etc., Bull. 34, Bur. Amer. Ethnol., Washington, 1908.

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A NEW SPECIES OF TREMATODE WORM OF THE GENUS ORNITHOBILHARZIA FROM A CANADIAN GOOSE

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Price (1929) has recently published a synopsis of the trematode family Schistosomidae, including in it descriptions of three new genera and species from North American hosts. In the present paper an additional new species is described. This schistosome was collected from a Canadian goose (*Branta canadensis canadensis*) forwarded to the Zoological Division of the Bureau of Animal Industry by Mr. W. L. McAtee of the Bureau of Biological Survey, the bird having been caught at Back Bay, Virginia. This fluke belongs to the subfamily Schistosominae Stiles and Hassall, 1898, and to the genus *Ornithobilharzia* Odhner, 1912. For this species the name *Ornithobilharzia pricei* is proposed. The description is based upon three males and three females, one of the latter being immature and another incomplete.

The characters of the genus as given by Price (1929) are as follows:

ORNITHOBILHARZIA Odhner, 1912

Synonym.—Macrobilharzia Travassos, 1923.

Generic diagnosis.—Schistosominae: Female shorter than male. Male with well formed gynaecophoric canal, formed by an infolding of the lateral edges of the body. Suckers present. Cuticle covered with spines. Digestive tract similar to that in *Schistosoma;* intestinal ceca long and showing a tendency to form several anastomoses before finally uniting to form the common cecum. Testes numerous (60 or more), commonly a short distance caudad of acetabulum, and extending into posterior half of body. Cirrus pouch rudimentary or absent. Seminal vesicle free in parenchyma; prostate absent. Genital pore small and situated immediately caudad of acetabulum. Female elongate, slender, and flattened. Ovary elongated, loosely or tightly coiled, and situated in anterior third of body. Vitellaria

extensive, occupying about two-thirds of the body length. Laurer's canal present (at least in some species). Uterus short and containing but one egg at a time.

Type species.—Ornithobilharzia intermedia Odhner, 1912.

ORNITHOBILHARZIA PRICEI, new species

Plate 1, Figures 1–4

Specific diagnosis.—Ornithobilharzia:

Male 5.3 to 6.2 mm. long and with a maximum width of 600 to 625μ. The lateral edges of the body are infolded ventrally to form a deep gynaecophoric canal. The cuticle is covered with small blunt spines. Oral sucker cup-like, subterminal, and 125 to 150μ in diameter; acetabulum circular, 185μ in diameter, and situated from 232 to 300μ caudad of the oral sucker. Both suckers are covered with fine spines. The esophagus is simple, weakly muscular, and bifurcates immediately in front of the acetabulum. The intestinal ceca are sinuous, provided with small diverticula, and unite about one-fifth of the body length from the posterior end. The common cecum runs a zig-zag course and terminates about 60μ from the posterior end of the body. The testes, 28 in number, are arranged in two alternating rows in the median line and occupy the second fifth of the body length; they originate about 450μ caudad of the acetabulum and extend backward as far as 1.5 mm. from it. The seminal vesicle is oval in shape and lies midway between the first testis and the acetabulum. A cirrus pouch appears to be absent. The genital pore is situated 175μ caudad of the acetabulum and to the left of the median line. The excretory pore is terminal; the details of the excretory system could not be made out.

Female longer than male. The cylindrical body is 9 mm. long, slender, having a thinner anterior part, about 50μ wide, which gradually becomes thicker and attains its maximum width of 112μ in the region of the ovary. The cuticle is covered with very fine spines. Oral sucker subterminal, poorly developed; acetabulum prominent, 60 to 70μ in diameter, and situated about 505μ caudad of the oral sucker. The esophagus is simple and bifurcates immediately in front of the acetabulum. The intestinal ceca are relatively short and sinuous, and unite about 3.1 mm. caudad of the oral sucker. The slender common cecum is very long, occupying about two-thirds of the body length. The elongated ovary is loosely coiled and occupies the second fifth of the body length; it originates about 1.8 mm. from the anterior end of the body, is 1.3 mm. long when measured in a straight line and disregarding the total length of the spiral, and terminates near the union of the ceca. The oviduct arises from the posterior pole of the ovary and runs ventral to it in

a sinuous manner to the ootype. The vitellaria consist of paired follicles extending from a short distance caudad of the union of the ceca to near the posterior end of the body. The vitelline duct extends anteriorly in a sinuous manner and joins the oviduct at the ootype. The uterus is muscular, short, and slightly coiled; no eggs were present in the specimens available for study. The genital pore is in the median ventral line immediately caudad of the acetabulum. Eggs collected from the intestinal contents are oval, 63 to 69μ long by 48 to 51μ wide, thin-shelled, provided with a small terminal spine, and contain active miracidia.

Host.—Branta canadensis canadensis.

Location.—Branches of portal and mesenteric veins.

Distribution.—North America (United States; collected at Washington, D. C., from a host from Back Bay, Va.).

Type specimens.—United States National Museum Helminthological Collection No. 29718; paratypes No. 29719.

This species differs from the other members of the genus *Ornithobilharzia* mainly in two points: (1) The number of testes is smaller; and (2) the females are longer than the males. On the other hand this fluke resembles *Ornithobilharzia intermedia* Odhner, 1912, the type of the genus, in many respects, especially as regards the elongated, loosely coiled ovary in the female. In order to bring the generic diagnosis given above in accordance with the characters of the new species, the following emendation is proposed: Female shorter or longer than male. Testes numerous (28 or more), extending into posterior half of body or confined to the anterior half.

For the purpose of separating *Ornithobilharzia pricei* from the other species of the genus the following key is appended:

KEY TO THE SPECIES OF THE GENUS ORNITHOBILHARZIA

1. Parasitic in mammals ..... 2.
   Parasitic in birds ..... 3.
2. Cuticle of male smooth; testes 70 to 80 in number; egg 72 to 74μ by 22 to 26μ, with a spinous process at each pole ..... O. turkestanicum.
   Cuticle of male tuberculate; testes 61 in number; egg 100 to 136μ by 44 to 60μ, with a spine at one pole ..... O. bomfordi.
3. Species inadequately described ..... 4.
   Species adequately described ..... 5.
4. Male 14 mm. long; oral sucker 364μ in diameter; acetabulum 560μ in diameter; female unknown; in *Hydrocoloeus melanocephalus* ..... O. kowalewskii.
   Male 16 mm. long; oral sucker 312μ by 104 to 160μ; acetabulum 450μ in diameter; female shorter than male; in *Thylasseus maximus* (=*Sterna galericulata*) ..... O. canaliculata.
5. Male 40 to 57 mm. long; testes 230 to 250 in number; female unknown. O. macrobilharzia.
   Male 11 mm. or less in length; female known ..... 6.

6. Male 5.3 to 6.2 mm. long; testes 28 in number and confined to anterior half of body; female longer than male ..... **O. pricei.**
Testes extending into posterior half of body; female shorter than male ..... 7.
7. Male 8 to 10.6 mm. long; testes 90 to 110 in number; intestinal ceca in female united immediately caudad of ovary ..... **O. intermedia.**
Male 6 to 7 mm. long; testes 65 in number; intestinal ceca in female unite a considerable distance caudad of ovary ..... **O. odhneri.**

The writer desires to acknowledge his indebtedness to Dr. M. C. Hall, Chief of the Zoological Division, Bureau of Animal Industry, United States Department of Agriculture, for the facilities placed at his disposal during a stay in the United States made possible by a fellowship from the International Health Board of the Rockefeller Foundation, and also to Dr. Emmett W. Price for his helpful advice in the preparation of this paper.

REFERENCE

PRICE, EMMETT W.
1929. A synopsis of the trematode family Schistosomidae, with descriptions of new genera and species. Proc. U. S. Nat. Mus., Wash., (2789), vol. 75, art. 18, pp. 1–39, pls. 1–15.

EXPLANATION OF PLATE

Ornithobilharzia pricei, new species

FIGURE 1. Male; ventral view.
2. Female; lateral view.
3. Female; genital system; lateral view.
4. Egg.

ABBREVIATIONS

ac., acetabulum.
c., common cecum.
cb., cecal branches.
gc., gynaecophoric canal.
gp., genital pore.
o., ootype.
oes., esophagus.
os., oral sucker.
ov., ovary.
ovd., oviduct.
sv., seminal vesicle.
t., testes.
ut., uterus.
vd., vitelline duct.
vit., vitellaria.

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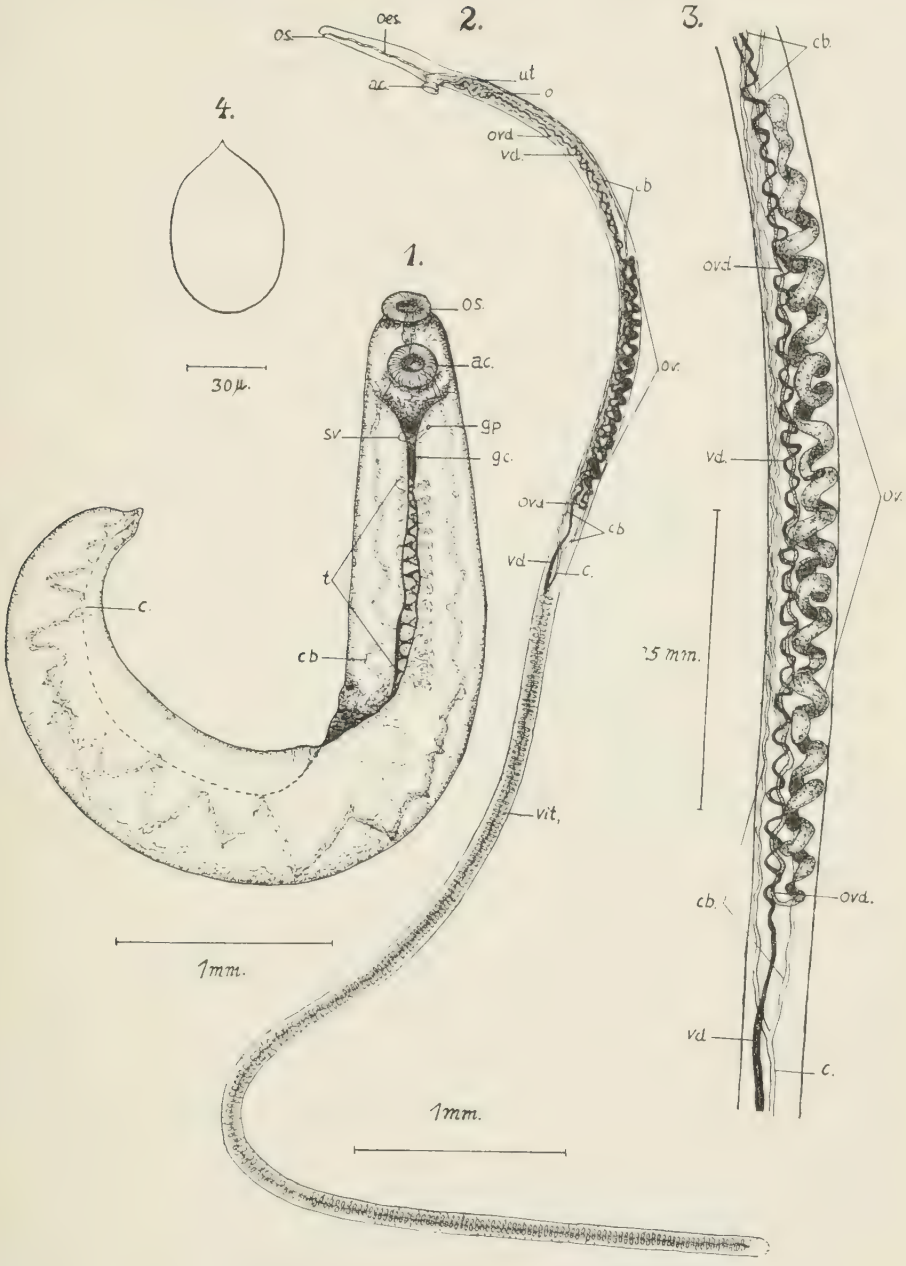

ORNITHOBILHARZIA PRICEI, NEW SPECIES

FOR EXPLANATION OF PLATE SEE PAGE 4

CAMBRIAN BIVALVED CRUSTACEA OF THE ORDER CONCHOSTRACA

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INTRODUCTION

The present work is the outgrowth of investigations of the Paleozoic Ostracoda pursued by the authors as opportunity offered. In the course of these studies a critical comparison with the Cambrian species referred by authors to the Ostracoda became desirable. Most of these Cambrian bivalved species have been described in the papers published by Dr. G. F. Matthew on the Cambrian faunas of New Brunswick and Nova Scotia. The types of Doctor Matthew's species are now in the collections of the Royal Ontario Museum of Paleontology at Toronto. Upon application to the Museum authorities some years ago, and through the courtesy of Prof. W. A. Parks, the described specimens were very kindly sent to us at Washington for restudy.

When, at that time, Dr. Charles D. Walcott learned that the types of Matthew's species of bivalved crustacea were in our hands, he suggested that we include in our studies the abundant material of a similar nature contained in the unrivaled collection of Cambrian fossils in the United States National Museum. This additional task being accepted, the material in hand had become so nearly a complete representation of the smaller bivalved crustacea (Conchostraca) of the American Cambrian that its treatment assumed the character of a monograph rather than the brief notes on the supposed Ostracoda described by Matthew.

It should be said that we have been especially careful in the matter of illustrations. With very few exceptions the new figures are all photographs that have been touched up just enough to attain that desirable medium stage between the authors' interpretation and the

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2607—31——1

untouched photograph. Practically all of the material studied occurs in a dark matrix, and it was necessary to whiten the specimens by the ammonium-chloride process before suitable photographs could be secured. This process has also proved almost invaluable in the study of the specimens, for by the application of the thin, smooth, white coating of ammonium chloride characters which are obscure in the unwhitened specimen flash out into relief.

In the following pages we are compelled to record mistakes due mainly to incomplete preparation of material, all of which might have been avoided had some process for clearing up the specific characters been available. In some cases the posterior side was mistaken for the dorsal edge of the valve; frequently the outlines of the valves were incorrectly figured, the true edges being hidden under the matrix, as subsequent investigation showed. Even when perfectly prepared great care must be exercised in the study of these small crustacea, for their thin, flexible, and membranaceous shells are very liable to distortion or crushing. Numerous specimens are sometimes necessary to determine the true form of a species, and in this respect, as noted above, the present writers have been particularly fortunate in having at their service the great Cambrian collection accumulated by Doctor Walcott during a half century of unremitting effort.

As before stated, only the small ostracodelike bivalved crustacea of the Cambrian are considered in this paper. The great majority of the species are arranged in three closely related families, the Bradoriidae, Beyrichonidae, and Indianidae, while the remaining forms are referred to the recent Limnadiidae or have been left uncertain. Our studies upon these crustacea were well under way in 1913, so that the junior author was then able to definitely place these so-called Cambrian Ostracoda in the Order Conchostraca of the old division Phyllopoda in his discussion of the Branchiopoda in the second edition of the Zittel-Eastman Textbook of Paleontology.

The larger Cambrian crustacea classified under *Isoxys*, *Hymenocaris*, and various genera proposed by Walcott are not considered in the present paper, but their position in the classification is indicated in the table on a succeeding page.

The Cambrian bivalve crustacea referred by Matthew and others to the Ostracoda certainly do not belong to that superorder. In all of the forms studied by us, with the exception possibly of certain species placed in the emended genus *Indiana*, the main muscle spot is located close to the anterocardinal angle just behind and beneath the ocular tubercle, whereas in the Ostracoda what is regarded as the corresponding scar is located somewhere near the middle of the valves. In at least one of the species of *Indiana*—*I. primaeva* (*Leperditia? primaeva*, Matthew)—an obscure subcircular scar is located very near the center of the valves. In all, however, the composition of

the shell is different, being thinner, more membranaceous, often flexible, and, if not strictly corneous, at least less calcareous than in the Ostracoda. Again, the valves are not so completely separated, there being, indeed, some reason for believing that the valves were always tightly joined along the back, often perhaps by fusion of the cardinal edges. In the Ostracoda the valves are always completely separated, the hingement along the back being effected by mere overlaps or by means of interlocking bars or teeth. In the Bradoriidae, finally, the margins of the valves, except along the back, are apart, the edges being so opposed that a narrow slit separates them. A somewhat similar condition occurs among Ostracoda only in the Cypridinidae in which the closed valves leave an incision and often a keyhole-like slit beneath the anterior "hook."

For the reasons mentioned we are confident that the Bradoriidae and allied Cambrian crustacea are not true Ostracoda. However, as they precede the Ostracoda in time, it is quite probable that the latter were derived from the earlier Bradoriidae and Beyrichonidae. That they stand in such relationship is indicated by the fact that the Leperditiidae, the oldest representatives of the true Ostracoda, present more resemblances to these Cambrian bivalves than can be seen, with the exception possibly of the Cypridinidae, in any of the succeeding genera of the order. The Cypridinidae in that case may represent a reversion to ancestral characteristics—a condition indicated in Carboniferous representatives of other classes of organisms.

The correct classification of the small Cambrian bivalved crustacea is a difficult question. If the superorder Branchiopoda were to include the Phyllocarida as an order or were considered as closely allied, we would not hesitate to place them in the same general association, as we are impressed with the view that these Cambrian forms are an early phase or offshoot of the stock from which the Branchiopoda and Phyllocarida on the one hand and the Ostracoda on the other were derived.

To-day the term Branchiopoda is employed as a superorder to include the three distinct orders Anostraca, Notostraca, and Conchostraca, formerly considered as groups of the old division Phyllopoda, and a fourth order Cladocera, while the superorder Malacostraca contains all the higher crustacea with the Phyllocarida as its first division. The dorsal nodes and ridges marking the valves of the Bradoriidae and Beyrichonidae suggest closer relationship with the usually much larger Phyllocarida than with the typical fossil Phyllopoda (as *Estheria* and *Leaia*) of the order Conchostraca whose average size is about as in their supposed Cambrian progenitors. Perhaps this supposed relationship is only a case of parallel development, but at any rate it is obvious that until the body segments and appendages of these particular families have been discovered their exact classifica-

tion must be only provisional. Tentatively, therefore, we will refer them to the order Conchostraca of the superorder Branchiopoda.

In the table below we give our present idea of the classification of the Conchostraca and of the Cambrian and allied genera of related branchiopod crustacea.

CLASSIFICATION OF CAMBRIAN CONCHOSTRACA AND ALLIED GENERA

Class CRUSTACEA

Subclass Eucrustracea

Superorder BRANCHIOPODA Latreille (PHYLLOPODA, part)

Order ANOSTRACA Sars

Opabinia, *Leanchoilia*, *Yohoia*, and *Bidentia*, all of Walcott and from the Middle Cambrian of British Columbia.

Order NOTOSTRACA Sars

Protocaris Walcott; Lower Cambrian, Vermont.

Ribeiria Sharpe and *Ribeiriella* Shubert and Waagen; Canadian and Early Ordovician of Europe and America.

Apus Latreille, Trias-Recent; *Lepidurus* Leach, Recent.

Burgessia Walcott; Middle Cambrian of British Columbia.

Isoxys Walcott; Cambrian.

Euchasma, *Eopteria*, and *Ischyrina* of Billings, and *Technophorus*, Miller; Canadian, Ordovician and Early Silurian.

Order CONCHOSTRACA Sars

Family BRADORIIDAE Matthew

Bradoria Matthew (*Bradorona* Matthew); Lower and Middle Cambrian.

Walcottella, new genus; Middle Cambrian.

Family BEYRICHONIDAE, new family

Beyrichona Matthew (*Escasona* Matthew); Lower and Middle Cambrian.

Sellula Wiman; Lower Cambrian, Sweden.

Aluta Matthew; Lower and Middle Cambrian.

Eremos Westergaard; Canadian of Sweden.

Hipponicharion Matthew; Lower and Middle Cambrian.

Polyphyma Groom; Middle and Upper Cambrian.

Family INDIANIDAE, new family

Indiana Matthew; Lower and Middle Cambrian.
Dielymella, new genus; Lower and Middle Cambrian.
Mononotella, new genus; Lower Cambrian.

Family LIMNADIIDAE Baird

Estheria Ruppel; Devonian-Pleistocene.
Leia Jones; Carboniferous of Europe and North America.
Estheriella Weiss; Permian of Russia and Saxony.
Schizodiscus Clarke; Middle Devonian of New York.
Lepiditta Matthew; Lower and Middle Cambrian.
Fordilla Walcott; Lower Cambrian.
Modioloides Walcott; Lower Cambrian.
Lepidilla Matthew; Middle Cambrian.

Superorder MALACOSTRACA Latreille

Order PHYLLOCARIDA Packard

Suborder HYMENOCARINA Clarke

Hymenocaris Salter; Cambrian.
Anomalocaris Whiteaves, *Hurdia*, *Tuzoia*, *Odaraia*, *Fieldia*, *Carnarvonia*, and *Waptia* all of Walcott from the Middle Cambrian of British Columbia.

Suborder CERATIOCARINA Clarke

Ceratiocaris McCoy, *Nothozoe* Barrande; Ordovician, etc.
Caryocaris Salter; Cambrian, Ordovician.

Suborder DISCINOCARINA Clarke

Shafferia Walcott; Cambrian.
Aptychopsis Barrande; Cambrian, Ordovician.

The following section shows the sequence of formations in Cape Breton and New Brunswick, the correlation of the zones distinguished by Matthew with the Walcott locality numbers as described in his Cambrian Brachiopod Monograph, and the fauna of Conchostraca in the various zones.

SECTION, GIVING FORMATIONS WITH FAUNAS OF CONCHOSTRACA CAPE BRETON AND NEW BRUNSWICK

Canadian:

Upper Bretonian (Matthew, 1903).
Division C3*c*2 (*Asaphellus* zone).
Division C3*c* (*Dictyonema* zone).

Ozarkian:

Lower Bretonian.

Division C3*b* (*Peltura* zone).

Division C3*a* (*Parabolina* zone).

Cambrian:

Middle Cambrian (St. John group—Johannian division of Matthew, 1903.)

Division C2*c*.

Division C2*b* (*Forchhammeri* zone 3*h*, 3*i*, 10*s*, 307*g*) *Beyrichona triceps, Hipponicharion confluens, H. parvum, H. plicatum.*

Division C2*a*.

Middle Cambrian (St. John group-Acadian division of Matthew, 1903, *Paradoxides zones*).

Division C1*d* (*Lepiditta curta*).

Division C1*c*1, C1*c*2 (2*l*, 2*s*) (*Aluta flexilis, Beyrichona tinea, Indiana dermatoides, I. acadica, I. matthewi, I. primaeva, Lepiditta alata, L. auriculata, Lepidilla anomala.*)

Lower Cambrian (St. John group, Hanfordian division of Van Ingen, 1914, *Protolenus* zone)

Division C1*b*5.

Division C1*b*4 (*Beyrichona papilio, B. tinea*).

Division C1*b*3 (*2i, 2k*) (*Beyrichona benepuncta, B. cambrica, B. minor, B. oculata, B. papilio, B. rotundata, B. tinea, B. tinea planata, B. tinea triangula, Hipponicharion cavatum, H. minus, Indiana dermatoides, I. lippa, I. longula, I. matthewi, I. primaeva, I. pyriformis, I. secunda, Lepiditta sigillata, Mononotella fusiformis*).

Division C1*b*2 (2*h*, 301) (*Beyrichona ovata, B. papilio, B. rotundata, B. tinea, B. tinea planata, Entomidella buprestis, Indiana secunda, Bradoria primaeva*).

Division C1*b*1 (2*g*) (*Beyrichona tinea planata, Bradoria aurora, B. robusta, B. steadi, Leperditia ventricosa, Hipponicharion eos, H. cavatum*).

Lower Cambrian (Etcheminian, Matthew, 1903).

Division E3*f* (13*m*, 13*n*, 344*d*) (*Beyrichona rutellum, Bradoria acuta, B. robusta, B. scrutator, Indiana lippa, Mononotella fusiformis*).

Division E3*e* (13*n'*) (*Bradoria acuta, B. ovalis, B. robusta, B. rugulosa, B. scrutator, B. spectator, B. vigilans, Indiana lippa, Schmidtella pervetus*).

Division E3*d* (13*n''*, 344*b*) (*Bradoria acuta, B. benepuncta, B. elongata, B. obesa, B. robusta, B. scrutator, B. spectator spinosa, B. vigilans, B. vigilans concentrica*).

Division E3*c* (344*a*) (*Bradoria scrutator, B. acuta*).

Cambrian—Continued.

Lower Cambrian—Continued.

Division E3*b*.

Division E3*a* (13*l*, 13*l'*) (*Bradoria acuta, B. curta*).

Division E2*c* (13*e*, 344*l*) (*Bradoria acuta, B. rugulosa*)

Division E2*b* (10*p*, 10*p'*, 10*p''*, 10*q*) (*Bradoria acuta, B. benepuncta, B. benepuncta spissa, B. elongata, B. medialis, B. obesa, B. ovalis, B. perspicator, B. robusta, B. spectator, B. vigilans*).

Division E2*a* (13*d*, 13*d'*, 13*d''*, 13*g*) (*Bradoria benepuncta, B. perspicator, B. robusta, B. rugulosa*).

Division E1*e* (344*h*) (*Bradoria spectator spinosa, B. ovalis*).

Division E1*d* (13*t''*, 344*d*, 344*e*) (*Bradoria acuta, B. benepuncta, B. concinna, B. obesa, B. perspicator, B. robusta, B. spectator, B. subquadrata*).

Division E1*c* (344*g*) (*Bradoria acuta, B. benepuncta, B. concinna, B. obesa, B. ornata, B. robusta, B. rugulosa, B. perspicator, B. spectator*).

Division E*b* (13*t*, 13t', 344k) (*Bradoria acuta, B. benepuncta, B. benepuncta spissa, B. obesa, B. robusta, B. robusta longula, B. rugulosa, B. spectator*).

Division E1*a*.

Lower Cambrian (Coldbrookian, Matthew, 1903) (13*k*, 344*f*) (*Bradoria ovalis prima, Escasona ingens*).

An alphabetic list with cross references and the geologic occurrence of the species treated in this paper follows.

ALPHABETIC LIST OF NAMES APPLIED TO CAMBRIAN CONCHOSTRACA

Aluta Matthew.
Aluta bergeroni (Walcott)—Middle Cambrian (China).
Aluta douvillei (Mansuy)—Cambrian (Yunnan).
Aluta enyo (Walcott)—Middle Cambrian (China).
Aluta eros (Walcott)—Middle Cambrian (China).
Aluta flexilis Matthew—Middle Cambrian (Acadian, C1C2).
Aluta fragilis (Walcott)—Middle Cambrian (China).
Aluta hollii (Jones)—Cambrian-Menevian (Wales).
Aluta primordialis (Linnarsson)—Middle Cambrian (Sweden).
Aluta rimulata, new species—Middle Cambrian (British Columbia).
Aluta rotundata (Walcott)—Lower Cambrian (New York).
Aluta stereope (Walcott)—Middle Cambrian (China).
Aluta troyensis (Ford)—Lower Cambrian (New York).
Aluta woodi (Walcott)—Middle Cambrian (China).
Aparchites anderssoni Wiman=*Indiana anderssoni*.
Aparchites fennicus Wiman=*Bradoria fennicus*.
Aparchites robustus Matthew=*Bradoria robusta*.
Aparchites secunda Matthew=*Indiana secunda*.
Aristozoe rotundata Walcott=*Aluta rotundata*.

Aristozoe troyensis Ford=*Aluta troyensis.*
Beyrichia angelini Barrande=*Polyphyma angelini.*
Beyrichia angelini armata Gronwall=*Polyphyma armata.*
Beyrichia hollii Jones=*Aluta hollii.*
Beyrichia? primaeva Matthew=*Bradoria primaeva.*
Beyrichia triceps Matthew=*Beyrichona triceps.*
Beyrichona Matthew.
Beyrichona alta Wiman.....Lower Cambrian (Sweden).
Beyrichona faba Wiman.....Lower Cambrian (Sweden).
Beyrichona gevalensis Wiman.....Lower Cambrian (Sweden).
Beyrichona ovata (Matthew).....Lower Cambrian (Hanfordian, C1*b*2).
Beyrichona papilio Matthew.....Lower Cambrian (Hanfordian, C1*b*2–C1*b*4).
Beyrichona planata Matthew=*Beyrichona tinea planata.*
Beyrichona rotundata Matthew.....Lower Cambrian (Hanfordian, C1*b*2, C1*b*3).
Beyrichona? rutellum (Matthew).....Lower Cambrian (Etcheminian, E3*f*).
Beyrichona tinea Matthew.....Lower Cambrian (Hanfordian, C1*b*2–C1*b*4).
Beyrichona tinea planata (Matthew)..Lower Cambrian (Hanfordian, C1*b*1–C1*b*3).
Beyrichona tinea triangula (Matthew).....Lower Cambrian (Hanfordian, C1*b*3).
Beyrichona triangula Matthew (part)=*B. tinea triangula.*
Beyrichona triangula Matthew (part)=*Beyrichona papilio.*
Beyrichona triceps (Matthew).....Middle Cambrian (Johannian, C2*b*).
Bradoria Matthew.
Bradoria acuta (Matthew)
Lower Cambrian (Etcheminian, E1*b*–E1*d*, E2*b*, E2*c*, E3*a*, E3*c*, E3*f*).
Bradoria aurora (Matthew).....Lower Cambrian (Hanfordian, C1*b*1).
Bradoria benepuncta (Matthew)
Lower Cambrian (Hanfordian, C1*b*3; Etcheminian, E1*b*, E1*d*, E2*a*, E2*b*, E3*d*).
Bradoria benepuncta spissa, new variety..Lower Cambrian (Etcheminian, E1b, E2*b*).
Bradoria bergeroni Walcott=*Aluta bergeroni.*
Bradoria cambrica (Matthew).....Lower Cambrian (Hanfordian, C1*b*3).
Bradoria concinna (Matthew).....Lower Cambrian (Etcheminian, E1*c*, E1*d*).
Bradoria curta, new species.....Lower Cambrian (Etcheminian, E3*a*).
Bradoria douvillei Mansuy=*Aluta douvillei.*
Bradoria elongata, new species.....Lower Cambrian (Etcheminian, E2*b*, E3*d*).
Bradoria enyo Walcott=*Aluta enyo.*
Bradoria eros Walcott=*Aluta eros.*
Bradoria fennicus (Wiman).....Cambrian (Sweden).
Bradoria fragilis Walcott=*Aluta fragilis.*
Bradoria hicksi (Jones).....Cambrian (Wales).
Bradoria medialis, new species.....Lower Cambrian (Etcheminian, E2*b*).
Bradoria minor (Matthew).....Lower Cambrian (Hanfordian, C1*b*3).
Bradoria nitida (Wiman).....Cambrian (Sweden).
Bradoria obesa (Matthew)..Lower Cambrian (Etcheminian, E1*b*–E1*d*, E2*b*, E3*d*).
Bradoria observator Matthew=*B. perspicator.*
Bradoria oculata (Matthew).....Lower Cambrian (Hanfordian, C1*b*3).
Bradoria ornata (Matthew).....Lower Cambrian (Etcheminian, E1*c*).
Bradoria ovalis (Matthew).....Lower Cambrian (Etcheminian, E1*c*, E2*b*, E3*c*)
Bradoria ovalis mut *prima* Matthew.....Lower Cambrian (Coldbrookian).
Bradoria perspicator (Matthew)..Lower Cambrian (Etcheminian, E1*d*, E2*a*, E2*b*).
Bradoria primaeva (Matthew).....Lower Cambrian (Hanfordian, C1*b*).
Bradoria robusta (Matthew)
Lower Cambrian (Hanfordian, C1*b*; Etcheminian, E1*b*-E1*d*, E2*a*, E2*b*, E3*d*-E3*f*).
Bradoria robusta longula, new variety.....Lower Cambrian (Etcheminian, E1*b*).

Bradoria rugosa Matthew=*Bradoria robusta.*
Bradoria rugulosa Matthew
Lower Cambrian (Etcheminian, E1*b*, E1*c*, E2*a*, E2*c*, E3*e*).
Bradoria scrutator Matthew----------Lower Cambrian (Echeminian, E3*c*–E3*f*).
Bradoria spectator (Matthew)
Lower Cambrian (Etcheminian, E1*c*, E1*d*, E2*b*, E3*e*).
Bradoria spectator spinosa (Matthew)-Lower Cambrian (Etcheminian, E3*d*, E1*e*).
Bradoria? steadi (Matthew)----------Lower Cambrian (Hanfordian, C1*b*1).
Bradoria stereope Walcott=*Aluta stereope.*
Bradoria subquadrata, new name (*Bradorona spectator acuta* Matthew)
Lower Cambrian (Etcheminian, E1*d*).
Bradoria tontoensis, new species----------Middle Cambrian (Arizona).
Bradoria vigilans Matthew-----Lower Cambrian (Etcheminian, E2*b*, E3*d*, E3*e*).
Bradoria vigilans (part)=*Bradoria obesa.*
Bradoria vigilans concentrica, new variety--Lower Cambrian (Etcheminian, E3*d*).
Bradoria vigilans obesa Matthew=*Bradoria obesa.*
Bradoria woodi Walcott=*Aluta woodi.*
Bradorona Matthew=*Bradoria.*
Bradorona nitida Wiman=*Bradoria nitida.*
Bradorona observator Matthew=*Bradoria perspictor.*
Bradorona observator benepuncta Matthew=*Bradoria benepuncta.*
Bradorona observator mut *laevis* Matthew=*Bradoria rugulosa.*
Bradorona observator mut *ligata*=*Bradoria scrutator* and *B. acuta.*
Bradorona perspicator Matthew=*Bradoria perspicator.*
Bradorona perspicator mut *magna* Matthew=*Bradoria robusta.*
Bradorona perspicator mut *major* Matthew=*Bradoria robusta.*
Bradorona perspicator mut *maxima* Matthew=*Bradoria robusta.*
Bradorona spectator Matthew=*Bradoria spectator.*
Bradorona spectator var. *acuta* Matthew=*Bradoria subquadrata.*
Bradorona spectator mut *aequata* Matthew=*Bradoria spectator spinosa.*
Bradorona spectator mut *spinosa* Matthew=*Bradoria spectator spinosa.*
Bythocypris polita Steusloff=*Lepiditta polita.*
Dielymella, new genus.
Dielymella appressa, new species----------Middle Cambrian (Arizona).
Dielymella brevis, new species----------Lower Cambrian (Vermont).
Dielymella dorsalis, new species----------Middle Cambrian (Arizona).
Dielymella nasuta, new species----------Middle Cambrian (Arizona).
Dielymella recticardinalis, new species----------Middle Cambrian (Arizona).
Dielymella recticardinalis angustata, new variety----Middle Cambrian (Arizona).
Entomidella? buprestis (Salter)----------Cambrian (Wales); Hanfordian, C1*b*2).
Entomis buprestis Jones=*Entomidella buprestis.*
Eremos Westergaard.
Eremos bryograptorum Westergaard----------Canadian (Sweden).
Escasona Matthew=*Beyrichona.*
Escasona? ingens Matthew. Not recognizable-Lower Cambrian (Coldbrookian).
Escasona? ovata Matthew=*Beyrichona ovata.*
Escasona rutellum Matthew=*Beyrichona? rutellum.*
Escasona? vetus Matthew. Not recognizable
Lower Cambrian (Etcheminian; E1*d*).
Fordilla Walcott.
Fordilla troyensis Walcott----------Lower Cambrian (New York).
Hipponicharion Matthew.
Hipponicharion cavatum----------Lower Cambrian (Hanfordian, C1*b*1-C1*b*3).
Hipponicharion confluens, new species-------Middle Cambrian (Acadian, C2*b*1).

Hipponicharion cos Matthew—Lower Cambrian (Hanfordian, C1*b*1).
Hipponicharion matthewi Wiman—Lower (Middle ?) Cambrian (Sweden).
Hipponicharion minus Matthew—Lower Cambrian (Hanfordian, C1*b*3).
Hipponicharion parvum, new species—Middle Cambrian (Acadian, C2*b*).
Hipponicharion plicatum, new species—Middle Cambrian (Cape Breton).
Indiana Matthew.
Indiana acadica (Matthew)—Middle Cambrian (Acadian, C1*c*1).
Indiana anderssoni Wiman—Cambrian (Sweden).
Indiana cambrensis (Hicks)—Cambrian (Wales).
Indiana curta, new species—Middle Cambrian (Arizona).
Indiana dermatoides (Walcott)
Lower Cambrian (Hanfordian, C1*b*3 and Georgian of New York).
Indiana faba, new species—Middle Cambrian (Arizona).
Indiana faba intermedia, new variety—Middle Cambrian (Arizona).
Indiana fusiformis Matthew=*Mononotella fusiformis.*
Indiana impressa, new species—Middle Cambrian (Arizona).
Indiana labiosa, new species—Middle Cambrian (British Columbia).
Indiana lentiformis Cobbold—Lower Cambrian (England).
Indiana lippa Matthew
Lower Cambrian (Hanfordian, C1*b*3; Etcheminian, E3*e*, E3*f*).
Indiana longula, new species—Lower Cambrian (Hanfordian, C1*b*3).
Indiana matthewi, new species
Lower Cambrian (Hanfordian, C1*b*3); Middle Cambrian (Acadian, C1*c*).
Indiana minima Wiman—Middle Cambrian (Sweden).
Indiana ovalis Matthew=*Bradoria ovalis.*
Indiana ovalis prima Matthew=*Bradoria ovalis.*
Indiana primaeva (Matthew)
Lower Cambrian (Hanfordian, C1*b*3); Middle Cambrian (Acadian, C1*c*).
Indiana pyriformis (Matthew)—Lower Cambrian (Hanfordian, C1*b*3).
Indiana robusta Matthew=*Bradoria robusta.*
Indiana secunda (Matthew)—Lower Cambrian, Hanfordian, C1*b*2).
Indiana solvensis (Jones)—Cambrian (Wales).
Indiana suberecta, new species—Lower Cambrian (New York).
Isochilina sweeti Chapman—Upper Cambrian (Australia).
Isochilina ventricosa Matthew=*Leperditia? ventricosa.*
Leperditia buprestis Salter=*Entomidella buprestis.*
Leperditia cambrensis Hicks=*Indiana cambrensis.*
Leperditia capsella Chapman—Upper Cambrian (Australia).
Leperditia dermatoides Walcott=*Indiana dermatoides.*
Leperditia ebenina Dwight—Middle Cambrian (New York).
Leperditia hicksii Jones=*Bradoria hicksii.*
Leperditia? minor Matthew=*Bradoria minor.*
Leperditia primaeva Matthew=*Indiana primaeva.*
Leperditia primordialis Linnarsson=*Aluta primordialis.*
Leperditia punctatissima Salter=*Entomidella? buprestis.*
Leperditia? rugosa Matthew=*Bradoria robusta.*
Leperditia cf. *solitaria* Barrande—Cambrian (Massachusetts).
Leperditia solvensis Jones=*Indiana solvensis.*
Leperditia? steadi Matthew=*Bradoria steadi.*
Leperditia tatei Chapman—Upper Cambrian (Australia).
Leperditia troyensis Ford=*Aluta troyensis.*
Leperditia? ventricosa (Matthew)—Lower Cambrian (Hanfordian, C1*b*1).
Leperditia vexata Hincks—Cambrian-Menevian (Wales).
Lepidilla Matthew.

Lepidilla anomala Matthew.....Middle Cambrian (Acadian, C1c2).
Lepiditta Matthew.
Lepiditta alata Matthew.....Middle Cambrian (Acadian, C1c2).
Lepiditta auriculata Matthew.....Middle Cambrian (Acadian, C1c1).
Lepiditta curta Matthew.....Middle Cambrian (Acadian, C1*d*1).
Lepiditta polita (Steusloff).....Middle Cambrian drift (Germany).
Lepiditta sigillata Matthew.....Lower Cambrian (Hanfordian, C1*b*3).
Modioloides Walcott.
Modioloides prisca Walcott.....Lower Cambrian (New York).
Modiolopsis thecoides Matthew.Lower Cambrian (Etcheminian), Newfoundland.
Mononotella, new genus.
Mononotella fusiformis (Matthew).
Lower Cambrian (Hanfordian, C1*b*3; Etcheminian, E3*f*).
Nothozoe? vermontana Walcott (part)=*Dielymella brevis.*
Polyphyma Groom.
Polyphyma angelini (Barrande).....Upper Cambrian (Sweden).
Polyphyma armata (Grönwall).....Middle Cambrian (Denmark).
Polyphyma lapworthi Groom.....Cambrian (England).
Polyphyma marginata, new species.....Upper Cambrian (Newfoundland).
Primitia acadica Matthew=*Indiana acadica.*
Primitia aurora Matthew=*Bradoria aurora.*
Primitia? fusiformis Matthew=*Mononotella fusiformis.*
Primitia oculata Matthew=*Bradoria oculata.*
Primitia pyriformis Matthew=*Indiana pyriformis.*
Primiitia simplex lloydiana Jones.....Cambrian (Newfoundland).
Primitia simplex milneana Jones.....Cambrian (Newfoundland).
Primitia simplex sanctojohannensis Jones.....Cambrian (Newfoundland).
Primitia solvensis Jones=*Indiana solvensis.*
Schmidtella acuta Matthew=*Bradoria acuta.*
Schmidtella cambrica Matthew=*Bradoria cambrica.*
Schmidtella? pervetus Matthew=Unrecognizable.
Lower Cambrian (Etcheminian, E3*e*).
Schmidtella? pervetus mut concinna Matthew=*Bradoria concinna.*
Sellula Wiman.
Sellula fallax Wiman.....Lower Cambrian (Sweden).
Walcottella, new genus.
Walcottella apicalis, new species.....Middle Cambrian (Arizona).
Walcottella breviuscula, new species.....Middle Cambrian (Arizona).
Walcottella concentrica, new species.....Middle Cambrian (Arizona).
Walcottella leperditoides, new species.....Middle Cambrian (Arizona).
Walcottella limatula, new species.....Middle Cambrian (Arizona).
Walcottella longula, new species.....Middle Cambrian (Arizona).
Walcottella nitida, new species.....Middle Cambrian (Arizona).
Walcottella oblonga, new species.....Middle Cambrian (Arizona).
Walcottella obsoleta, new species.....Middle Cambrian (Arizona).
Walcottella pulchella, new species.....Middle Cambrian (Arizona).
Walcottella scitula, new sepcies.....Middle Cambrian (Arizona).
Walcottella subtruncata, new species.....Middle Cambrian (Arizona).
Walcottella ventrosa, new species.....Middle Cambrian (Arizona).

SYSTEMATIC DESCRIPTIONS

Class CRUSTACEA

Superorder BRANCHIOPODA Latreille

Order CONCHOSTRACA Sars

Family BRADORIIDAE Matthew

Bivalved Conchostraca equivalved or possibly slightly inequivalved, with a straight hinge line. Surface closely punctate, otherwise even except for a more or less conspicuous node, the ocular tubercle, located near the antero-dorsal corner (*Bradoria*) and of an additional eminence in the median third of the length, believed to be the muscle spot (*Walcottella*). Shell structure calcareo-corneous to phosphatic.

Genus BRADORIA Matthew

Bradoria MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, No. 18, 1899, p. 204; Canadian Rec. Sci., vol. 8, 1902, p. 451.—JONES Geol. Mag., Dec. 4, 1902, p. 402, text fig. 5.—MATTHEW, Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 162 (genotype *B scrutator* Matthew).

Bradorona MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 444.—JONES, Geol. Mag., Dec. 4, 1902, p. 402, text fig. 2.—MATTHEW, Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 156 (genotype *B. perspicator* Matthew).

(Including *Indiana* (part), *Schmidtella*, and *Leperditia* Matthew).

After a careful comparison of all the species referred by Matthew to *Bradoria*, to the subgenus *Bradorona*, to *Schmidtella* and *Leperditia*, and in addition a number of undescribed species in the Walcott collection, we conclude there is absolutely no valid ground for either generic or subgeneric distinction between the several groups. The only difference between *Bradoria* and *Bradorona* is that while in the former the ventral outline is rather broadly and almost uniformly curved, in *Bradorona* it is more or less produced; hence more abruptly curved medially or at some point behind the middle. In consequence of this slight, and certainly not generic, difference, the proportionate height of the valves is less in *Bradoria* than in *Bradorona*. It is a fact, however, that even in the most typical *Bradoria* (*B. scrutator*) the ventral outline is less broadly curved than presented in Matthew's figures of the species; and from this we pass by such gradual steps to *Bradorona perspicator* and *B. spectator*, in which (of Matthew's species) the median production of the ventral outline is most conspicuous, that the observer can not fail to be impressed with the invalidity of the distinction.

Regarding the species referred by Matthew to *Leperditia*, namely *L.* ? *rugosa* and *L. minor*, and to *Schmidtella*, namely *S. pervetus*, *S.*

pervetus concinna, *S. cambrica*, and *S. acuta*, these agree in all essential respects with *Bradoria*. In the so-called Schmidtellae the form is short and tumid, but not more so than in certain species of *Bradorona* (as *B. obesa*). Except *Schmidtella ? pervetus concinna*, in which the ocular tubercle is barely distinguishable, all of the other species named in this paragraph have this tubercle more or less well developed. Variability in prominence of the "eye tubercle" in the Leperditiidae, however, is so common and has been proved to be of such little consequence in the generic grouping of the species that a similar inconsequence is suggested for the variation of the corresponding tubercle in these Cambrian crustaceans. Indeed, as a study of abundant material in Doctor Walcott's collection shows, individuals even may vary considerably in the relative development of the "eye tubercle." Considering species, the possibility of duplication under separate generic heads was immediately suggested, and before we had progressed very far in our study of the Matthew types, such duplication was demonstrated. It was induced, in the cases in mind, sometimes by exaggerated values ascribed to nonessential variations in development, but oftener through imperfections in preservation or incomplete preparation of the specimens.

The genus *Indiana* is noted above as a synonym in part. But if it were insisted that when no genotype is designated the first species following the generic description is to be so regarded, the genus could not stand. The first species, namely, *Indiana ovalis*, is an unquestionable *Bradoria*, being in fact a close ally of *B. rugulosa* and *B. robusta*. In this case, however, we think it advisable to transfer the rank of genotype to *I. lippa* one of two or three clearly congeneric species referred to the genus when it was first described by Matthew. Restricted to these and similar species, *Indiana* is distinguished by its oval, smooth form and total absence of the ocular tubercle. The gap between the valves is greater, and this, together with the other differences, probably indicates peculiarities of more serious import than can be established now.

All of the species of *Bradoria* as here revised bear a single node, the ocular tubercle. This, while always close to the anterocardinal angle, varies considerably in prominence. Rarely it is barely distinguishable, but as a rule it is a conspicuous feature, and not infrequently the definition of its base is emphasized by a narrow depression extending in part or entirely around it. In most of the species the outline of the valves is more or less distinctly divisible into five unequal sides. The angles marking off these sides are sometimes sharp, never equally so, the ventral angle generally the least acute, and in some cases all but the two defining the upper and lower extremities of the truncated, narrow anterior end are practically obsolete. The narrowest of the five sides is terminated above by the

posterior extremity of the straight cardinal edge and constitutes the upper one-fifth to one-third of the posterior margin. This short dorso-posterior side is best defined in species in which the remainder of the posterior outline trends somewhat forward, and manifestly least distinct in species like *B. robusta*, in which the backward trend prevails also in the lower part of this portion of the outline. In a few cases, notably *B. acuta*, and in a less degree *B. benepuncta* and *B. scrutator*, the general outline in a side view of the valves conforms to that of a right-angled triangle, the dorsal edge being the vertical, the posterior the base, and the ventral side the hypothenuse. As a rule the transverse diameter exceeds the vertical, in one case (a new species for which the name *B. elongata* is suggested), the dimensions being to each other about as 2 to 1. In the other extreme (likewise represented by a new species for which the name *B. curta* is suggested) the vertical diameter is considerably greater than the transverse.

All of these variations in form, however, are closely knit together by intermediate phases, and as no genetic departure from the generic type maintained throughout the whole group seems to have been established, a wholly satisfactory subgeneric grouping of the species has so far failed to suggest itself. Still, it may prove that the following provisional arrangement of the species in sections is more natural than we believe at present.

1. **Section of B. scrutator:**
   B. scrutator Matthew (genotype).
   B. oculata (Matthew).
   B. vigilans Matthew.
   B. vigilans concentrica, new variety.
   B. benepuncta (Matthew).
   B. benepuncta var. *spissa*, new variety.
   B. medialis, new species.
   B. acuta (Matthew).
   B. subquadrata, new name (=*B. spectator acuta* Matthew).
   B. elongata, new species.
2. **Section of B. rugulosa:**
   B. ovalis (Matthew).
   B. rugulosa Matthew.
   B. robusta (Matthew).
   B. robusta var. *longula*, new variety.
   B. tontoensis, new species.
3. **Section of B. perspicator:**
   B. perspicator (Matthew).
   B. spectator Matthew.
   B. spectator spinosa (Matthew).
   B. curta, new species.
4. **Section of B. cambrica:**
   ?B. obesa (Matthew).
   ?B. concinna (Matthew).
   B. cambrica (Matthew).
5. **Miscellaneous species:**
   Schmidtella pervetus Matthew.
   Bradoria minor Matthew.
   Bradoria? steadi Matthew.
   Bradoria primaeva (Matthew).
   Bradoria aurora Matthew.
   Bradoria? ornata Matthew.
   Bradoria fennicus (Wiman).
   Bradoria nitida (Wiman).
   Bradoria hicksi Jones.

BRADORIA SCRUTATOR Matthew

Plate 1, Figures 11, 12; Plate 3, Figure 11

Bradoria scrutator MATTHEW (part), Bull. Nat. Hist. Soc. New Brunswick, No. 18, 1899, p. 204, pl. 4, figs. 1*a*–1*c*; Canadian Record Sci., vol. 8, 1902, p. 451; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 163, pl. 13, figs. 1*a*–1*c*.

Bradorona observator mut. *ligata* MATTHEW (part), Canadian Record Sci., vol. 8, 1902, p. 451, pl. 1, fig. 17; Geol. Surv. Canada Rept. Cambrian Rocks Cape Breton, 1903, p. 162, pl. 12, fig. 17.

The type lot of this species, the genotype, contains three specimens, A, B, and C.[1] The one marked A is mostly a cast of the interior of *Bradoria benepuncta*, both the outline and contour of the valve and the punctations of a small patch of remaining shell agreeing with that species. B and C are evidently conspecific, and C is the specimen used by Matthew in illustrating the species. Matthew's figure of the left valve of this specimen (pl. 1, fig. 11) gives a false impression of the true outline, the ventral portion of the specimen being somewhat obscured by matrix and the whole carapace crushed so as to straighten this side a trifle and to expose the cardinal edge of the opposite right valve. The true outline of the valves—at any rate of the right, should the two, as seems highly improbable, be unequal—is more nearly approximated by specimen B. This indicates that the posterior half is proportionately wider than it is represented in Matthew's figure.

The characteristics of the species, as indicated by this specimen are (1) the rather uniform rounding of the posterior end, (2) the comparative obsolescence of the postcardinal and postventral angles, (3) the far anterior location of the ocular tubercle, and (4) the relatively coarse pattern of its surface punctation, but an excellently preserved example in the Walcott collections from the type locality shows that the posterior outline is sharply rounded in the postventral part and appreciably angulated in both the anteroventral and the postdorsal parts. On the whole, then, the outline of *B. scrutator* is somewhat obscurely quadrangular, thus agreeing better with the other species of its section of the genus.

Bradorona observator ligata Matthew is regarded as a synonym of *Bradoria scrutator*. The collection contains two specimens of this "mutation," both imperfect. They are quite distinct, one (A) being the same as the types of *B. scrutator*, the other (B) being a more triangular carapace and marked by exceedingly fine punctae (much finer than in *B. scrutator*). Neither is closely related to the typical form of *B. observator*. The specimen A is evidently the original of Matthew's Figure 17 and is accepted as the true type. This conclusion is fortified by the fact that this specimen alone fits the description in having "punctation rather coarse." This specimen is a trifle wider in the direction of the vertical diameter than usual in typical examples of *B. scrutator*, but this difference is certainly not of specific, and, in our opinion, not even of varietal, importance. The

[1] The Matthew types have been carefully lettered when a species is represented by more than one specimen. In such cases, Doctor Matthew probably used all the specimens in formulating his descriptions. It will be noted that in the present work we have found it necessary to restrict his types to the figured specimens in practically all cases.

postventral outline also seems less sharply curved, but this is due to imperfect preservation of the edge. The feature relied on by Matthew is a constriction, or rather a depression, in the dorsal edge of the exposed valve; but as no corresponding depression occurs on the opposite valve, the peculiarity is regarded as accidental and not structural. Hence mutation *ligata* is ranked as a synonym of *B. scrutator*.

The second specimen, B, though not perfect, is still good enough to leave no doubt in our minds as to its identity with the types of *Schmidtella acuta*. These are of an unquestionable species of *Bradoria*, but were misinterpreted by Matthew, who regarded the posterior end as dorsal.

Occurrence.—Lower Cambrian (Upper Etcheminian, division E3*c*–E3*f*): Dugald Brook, Cape Breton, Nova Scotia. Walcott locality 13*n'*.

Plesiotype.—Cat. No. 50540, U.S.N.M.

BRADORIA OCULATA (Matthew)

Plate 1, Figures 13, 14

Primitia oculata MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 136, pl. 8, figs. 2*a*, 2*b*.

Bradoria oculata MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, No. 18, 1899, p. 204.

The figures of the type and only example of this species do the specimen much more than justice, it being crushed so that we hesitate to decide definitely as to its affinities. Apparently it is a close ally of *B. scrutator*, the surface punctae being about equal in number (they are smaller but thicker walled), the outline about the same, and the ocular tubercles close to the anterior extremity as in that species. Without better specimens, however, it would be unwise to either refer *B. oculata* to synonymy or to recognize it as a good species.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*3): Hanford Brook, St. John County, New Brunswick.

BRADORIA VIGILANS Matthew, s. s.

Plate 1, Figure 15

Bradoria vigilans MATTHEW (part) Bull. Nat. Hist. Soc. New Brunswick, No. 18, 1899, p. 205, pl. 4, figs. 2*a*–2*c*; Canadian Rec. Sci., vol. 8, 1902, p. 454, pl. 2, figs. 2*a*–2*c*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 164, pl. 13, figs. 2*a*–2*c*.

Five specimens in Matthew's collection are called types of this species: A, B, C, D, and E. Of these the last is the original of Matthew's figures; hence it is regarded as the type of the species. On comparison it is found that D agrees exactly with the type E, while A and B agree much better; indeed, it is believed they agree in every

respect with *B. vigilans* mut. *obesa* Matthew, which is regarded as a good species and not a mere mutation. Finally, specimen C represents a distinguishable variety of *B. vigilans* s. s. described on a following page as *B. vigilans concentrica.*

The most striking feature common to all three specimens is the sharp definition and unusual prominence of the ocular tubercle. It is a more conspicuous feature even than would appear from the figure. In other respects the illustrations are fairly accurate for the typical form (specimens D and E). Compared with other species of the genus, the outline of this is peculiar in being rather narrowly rounded posteriorly and in the cardinal and ventral portions being more nearly parallel than in any of the others known. The anterior edge is somewhat thickened, the posterior end of the hinge projects as a thick blunt spine, and the surface punctation is rather fine. The affinities of the species as here restricted are with *B. scrutator* and *B. benepuncta*, differing from both in the narrow posterior part in having a postcardinal spine, a more prominent ocular tubercle, and finer surface punctae. As to the supposed mutation *obesa*, it is regarded as a very different species with relations to *B. cambrica* and *B. spectator*, rather than *B. vigilans.*

Occurrence.—Lower Cambrian (Upper Etcheminian division E2*b*, E3*d*, E3*e*): Dugald Brook, Cape Breton, Nova Scotia. Walcott localities 10*p*, 13*m*″, 13*n*″.

Cat. No. 50525, U.S.N.M.

BRADORIA VIGILANS CONCENTRICA, new variety

Plate 3, Figures 18, 19

Bradoria vigilans MATTHEW (part), Bull. Nat. Hist. Soc. New Brunswick, No. 18, 1899, p. 205; Canadian Record Sci. vol. 8, 1902, p. 454; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 164.

This new variety is represented by well-preserved specimens in the Walcott collection and by one of the types (C) of Matthew's *Bradoria vigilans.* Variety *concentrica* differs from the typical form of *B. vigilans* (1) in the more concentric arrangement of the surface punctae, a rugulose aspect being observable toward the edges, and (2) in the broader, thicker, straighter, and more nearly vertical trend of the anterior margin. The new variety suggests affinities to species of the *B. rugulosa* section, the approximation being toward *B. ovalis* rather than any of the other species of that section.

Occurrence.—Lower Cambrian (Upper Etcheminian, division E3*d*): Dugald Brook, Cape Breton, Nova Scotia. (Walcott locality 13*n*″.)

Cotypes.—Cat. No. 50527 U.S.N.M.

BRADORIA BENEPUNCTA (Matthew)

Plate 1, Figure 16; Plate 2, Figures 6, 7; Plate 3, Figure 7

Bradoria scrutator MATTHEW (part), Bull. Nat. Hist. Soc. New Brunswick, No. 18, 1899, p. 204; Canadian Record Sci., vol. 8, 1902, p. 451; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 163.

Bradorona observator var. *benepuncta* MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 449, pl. 1, fig. 16; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 161, pl. 12, fig. 16.

This form is not a mere mutation of *Bradorona observator* (= *Bradoria perspicator*), but should be ranked as a distinct species, differing sufficiently in outline to be recognized without much difficulty. It has longer and more oblique valves, the greatest ventral prominence being farther back, causing the antero-ventral outline to be straighter, longer and more oblique, and the posterior edge more nearly vertical. The punctation is very fine (about as in *B. perspicator* s. s.), but the nodes on the cardinal slope, mentioned in the original description, are not structural but due to sand grains.

Bradoria benepuncta, as the species may be called, is closely allied to *B. scrutator*, but in the latter species the punctation is coarser, the ocular tubercle nearer the anterior extremity, and the posterior outline not exactly the same. A closer ally, probably is *Bradoria subquadrata*, new name (= *Bradorona spectator acuta* Matthew), in which the punctation is similarly fine and the general outline not greatly different. While somewhat smaller, perhaps the only differences of any consequence are (1) that the ocular tubercle is nearer the anterior extremity in *B. subquadrata*, and (2) the outline, because of the sharper ventral angles and the more broadly truncated anterior end, more quadrangular.

Occurrence.—Lower Cambrian (Etcheminian, E1*b*-E1*d*, E2*a*, E2*b*, E3*d*; and Hanfordian, C1*b*3): Boundary Brook Escasonie, Cape Breton, Nova Scotia, and Hanford Brook, New Brunswick. Walcott localities 2*i*, 2*k*, 10*p*, 13*d*, 13*n''*, 13*n'*, 13*t*, Dugald Brook, Cape Breton, Nova Scotia.

Plesiotypes.—Cat. No. 50542, U.S.N.M. (13*n''*).

BRADORIA BENEPUNCTA SPISSA, new variety

Plate 2, Figures 8, 9

Several specimens in the Walcott collection indicate either a closely allied species or a good variety of *B. benepuncta*. Both forms appear to occur in nearly the same beds. The new one has a finer surface network and the posterior half of the outline more broadly rounded. Other, perhaps inconsequential, differences were noted on close comparison.

Occurrence.—Lower Cambrian (Etcheminian, E1*b*, E2*b*): Dugald Brook, Cape Breton. (Walcott locality 10*p*.) Occurs also at localities 10*p*'' and 13*t*.

Cotypes.—Cat. No. 50544, U.S.N.M.

BRADORIA MEDIALIS, new species

Plate 3, Figure 5

This is another apparently undescribed species. Its relations seem to be near *B. benepuncta* and the new variety of *B. robusta*—in fact, its systematic position is thought to be between these two species.

Occurrence.—Lower Cambrian (Etcheminian, E2*b*); Dugald Brook, Cape Breton, Nova Scotia. (Walcott *loc.* 10*p*.)

Holotype.—Cat. No. 50548 U.S.N.M.

BRADORIA ACUTA (Matthew)

Plate 1, Figure 25; Plate 3, Figures 1, 2

Schmidtella acuta MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, No. 18, 1899, p. 206, pl. 4, figs. 4*a*–4*c*; Canadian Record Sci., vol. 8, 1902, p. 465, pl. 11, figs. 12*a*–12*c*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 173, pl. 13, figs. 12*a*–12*c*.

Bradorona observator mut. *ligata* MATTHEW (part) Canadian Record Sci., vol. 8, 1902, p. 451; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 162.

Not *Bradorona spectator acuta* Matthew (=*Bradoria subquadrata*, new name).

The types of *Schmidtella acuta* and type specimen B of *Bradorona observator ligata* are unquestionably the same. As mentioned in notes on *Bradoria scrutator*, the figured type of the supposed mutation *ligata* (specimen A), is clearly distinct from specimen B, but can not be distinguished from typical specimens of *B. scrutator*. Concerning the types of *S. acuta*, there can be no doubt that Matthew mistook the nearly vertical and almost straight posterior margin for the dorsal edge. In two of his types (A and B), one or both of which were used by him in illustrating the supposed *Schmidtella*, the small yet sharply defined ocular tubercle is clearly visible near the narrow anterior extremity. This feature, as well as the very finely and closely punctate surface and a narrow marginal rim, is better preserved in specimens belonging to the Walcott collection. Basing our judgment upon all these specimens, we are satisfied that the species is a good *Bradoria*, related on the one side to *B. scrutator* and *B. benepuncta*, and on the other to *B. subquadrata* (=*B. spectator acuta* Matthew). At present it is the smallest species of the genus and is distinguished further by its narrow anterior end and decidedly triangular outline and from most others by its distinct though narrow marginal rim.

Occurrence.—Lower Cambrian (Etcheminian, E1*b*–E1*d*, E2*b*, E2*c*, E3*a*, E3*c*–E*cf*): Dugald Brook, Cape Breton. Walcott localities 10*p*, 13*l*, 13*m*″, 13*n*′.

Plesiotypes.—Cat. No. 50537, U.S.N.M.

BRADORIA SUBQUADRATA, new name

Plate 3, Figure 3

Bradorona spectator var. *acuta* MATTHEW (part), Canadian Record Sci., vol. 8, 1902, p. 447; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 159.

Not *Schmidtella? acuta* Matthew (=*Bradoria acuta*).

Of the three specimens labeled types of *Bradorona spectator* var. *acuta*, one (specimen C) is a poor mold of the exterior of some undeterminable yet undoubtedly distinct species of *Bradoria* from that represented by the other two specimens. The latter, marked "A" and "B", seem to be opposite valves of one species, A, however, being of an individual nearly twice the size of B. The "variety," as represented by these two specimens, is certainly not the same species as *B. spectator*, the outline of the valves being very different in the two forms. In *B. spectator* the ventral border is neatly rounded and its most prominent point but little behind the center of the valves. The posterior and anterior borders also are distinctly rounded. The outline of the types of the "variety," on the contrary, are so decidedly quadrangular that curvature is scarcely suggested. Indeed, the so-called variety is much more closely allied in general aspect and structure to *Bradoria acuta* (*Schmidtella? acuta*), differing only in the broader truncation of the anterior end in the somewhat sharper angulation of the postventral extremity, and in the very slightly coarser pattern of its surface punctation. Judging from specimen A the carapace grew to larger size than has been observed in *B. acuta* (1899). The ocular tubercle is not well preserved, but doubtless was smaller and rather inconspicuous.

As the name *acuta* is preoccupied in the genus *Bradoria* the new name, *Bradoria subquadrata*, is suggested for this species.

Occurrence.—Lower Cambrian (Lower Etcheminian, E1*d*): Dugald Brook and Boundary Brook, Escasonie, Cape Breton.

BRADORIA ELONGATA, new species

Plate 3, Figure 8

This new species is related to *Bradoria acuta* and *B. benepuncta* but is readily distinguished by its greater length, for which reason the name *B. elongata* is suggested. In this respect this new species differs from all other species of the genus now known.

Occurrence.—Lower Cambrian (Etcheminian, E2*b*, E3*b*): Dugald Brook, Cape Breton. (Walcott locality 10*q*., 13*n*''.)

Holotype.—Cat. No. 50541, U.S.N.M. (10*q*.)

BRADORIA OVALIS (Matthew)

Plate 1, Figure 18; Plate 3, Figure 6

Indiana ovalis MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 461, pl. 2, figs. 8*a*–8*c*.

Indiana ovalis and mutation *prima* MATTHEW, Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 170, pl. 13, figs. 8*a*–8*c*.

This fine species is represented by a single specimen in the set of Matthew's types before us.[2] Another much better preserved example is in the Walcott collection from Dugald Brook, the type locality. The shell of Matthew's type is mostly exfoliated and its outline somewhat obscured and injured in cleaning, but after a very careful comparison of the two specimens, we have not the least doubt of their specific identity. Judging more especially from the Walcott specimen, the species approximates *B. robusta* and *B. rugulosa* in surface ornament, and the former also somewhat in general form. It is, however, proportionately longer, has a narrower anterior end and rather more uniformly rounded posterior margin. In shape *B. ovalis* is not greatly different from *B. scrutator*, *B. benepuncta*, and *B. obesa*, but it is distinguished from the first two by its rounded posterior, from the latter by its more elongate form and narrower anterior, and from all three by the concentric arrangement and somewhat rugulose character of its surface markings.

The ocular node is well developed; hence the species has no very close relations to the species to which Matthew's genus *Indiana* is restricted.

Occurrence.—Lower Cambrian (Etcheminian, E1*e*, E2*b*, E3*e*): Dugald Brook, Cape Breton, Nova Scotia. Mutation *prima*, Coldbrookian, Dugald Brook.

Plesiotype.—Cat. No. 81378, U.S.N.M. (10*p*).

BRADORIA RUGULOSA Matthew, emended

Plate 1, Figure 17

Bradoria rugulosa MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, No. 18, 1899, p. 205, pl. 3, figs. 3*a*–3*d*; Canadian Record Sci., vol. 8, 1902, p. 456, pl. 11, figs. 3*a*–3*d*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 166, pl. 13, figs. 3*a*–3*d*.

Bradorona observator mut. *laevis* MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 450; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 161.

The three specimens upon which the so-called "mutation" *laevis* is founded are of the same form, but this form is not clearly related

[2] There are two specimens so labeled, but the second is undoubtedly distinct from the figured type, having coarser surface punctae and a general aspect suggesting identity with *B. scrutator* or *B. rigilans*.

to, and certainly not a mere mutation of, *B. observator*. It is a more oblique carapace with the most prominent point on the ventral outline farther behind the middle and the anterior end proportionally narrower than in that species. The surface marking also is quite different, consisting of fine pitting, or rather punctation, in *B. observator*, while in mutation *laevis* it consists of confluent granules, separating rows of minute punctae, arranged in a concentric manner. This type of marking characterizes *B. rugulosa*, and when the types of this species were more closely scrutinized it was found that they agreed not only in surface ornament but in shape as well. Matthew's figure of *B. rugulosa* would never suggest such a relationship, but it is a fact, nevertheless, the original of the figure being imperfect and partly covered by matrix on its posterior side. The other specimens of *B. rugulosa* in the type lot clearly prove the contention that this species is the same as the "mutation" *laevis*.

Occurrence.—Lower Cambrian (Upper Etcheminian, E1*b*, E1*c*, E2*a*, E2*c*, E3*e*): Dugald Brook, Cape Breton (mut. *laevis* = E1*b*).

Cat. Nos. 50514, 50515, U.S.N.M. (13*d*'', 13*t*).

BRADORIA ROBUSTA (Matthew)

Plate 1, Figures 1–5; Plate 2, Figures 1–4

Aparchites (?) *robustus* MATTHEW, Trans. Royal Soc. Canada, ser. 2, vol. 4, sect. 4, 1898, p. 132, pl. 1, figs. 4*a–c*.

Indiana? robusta MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 461.

Leperditia?? rugosa MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 443, pl. 1, figs. 7*a–c*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 155, pl. 12, figs. 7*a–c*.

Bradorona perspicator mut. *maxima* MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 445, pl. 1, figs. 9*a*, 9*b*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 157, pl. 12, figs. 9*a*, 9*b*.

Bradorona perspicator mut. *major* MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 446, pl. 1, figs. 10*a*, 10*b*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 158, pl. 12, figs. 10*a*, 10*b*.

Bradorona perspicator mut. *magna* MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 446, pl. 1, figs. 11*a*, 11*b*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 158, pl. 12, figs. 11*a*, 11*b*.

Bradoria robusta, or, as Matthew called it, *Aparchites* and later *Indiana robusta*, is represented by three specimens, A, B, and C, from division C1, B, Long Island, Kennebecasis River. A is a decorticated cast of the interior of a left valve, B and C are imperfect molds of the exterior of a left and a right valve, respectively. Though the material is not in condition admitting of a positive determination of the point, it is believed that A, which is regarded as the type of the species, is distinct from B and C and that the latter two molds are of a more elongate species, probably a form later called *Indiana pyriformis*, which seems to be a large variety of *Indiana secunda*.

As based on specimen A, we find that *Bradoria robusta* is the same species to which Matthew subsequently applied the names *Leperditia?? rugosa*, *Bradorona perspicator* mut. *maxima*, *B. perspicator* mut. *major*, and *B. perspicator* mut. *magna*. It is the largest of all the known St. Lawrence Atlantic province Bradoriidae.

Careful comparison and further cleaning of the types of the three supposed mutations of *B. perspicator* (*maxima*, *major*, and *magna*) prove to our full satisfaction that they are three examples of a single indivisible form or "mutation," and this a species that we think is readily enough distinguished from the types of *B. perspicator*. This other species, for which the earliest name *robusta* is selected, differs in being more oblique, more convex, and larger. Its normal form is a composite of Figures 3 and 4 of Plate 1 on which the three "mutations" are figured. The original of Figure 5 (mutation *magna*) was injured on the cardinal edge. Restoring this and removing matrix covering the post ventral edge, we have a nearly exact correspondence with Figure 4.

Another form figured on this plate, namely, *Leperditia?? rugosa*, almost certainly belongs to the same species as *B. robusta*. The original unfortunately is in bad condition, having evidently been crushed and distorted by pressure. This, like several other specimens of these peculiar Cambrian branchiopods, indicates by the crinkling of its shell that the same was much more pliable than any ostracod shell known to us; but there is so little doubt as to its original shape that we can not hesitate in referring it to the same species as *B. robusta*. The crushing of the type of *L. rugosa*, as is indicated by the accumulation of wrinkles, was especially effective along the ventral border, the consequent shortening of this thus giving the different outline as figured by Matthew. The name *robusta* is selected for the reason that in 1898 Matthew applied this name, under *Aparchites*, to another example of the same species.

A number of excellent specimens in the Walcott collection clearly proves that the surface ornamentation of *B. robusta* is essentially of the same concentrically rugulose pattern found in *B. rugulosa*. This, however, is a larger species and differs further in the obtuse angulation of the central part of the anterior edge, and the straightness of the outline between this angle and the anterior extremity of the hinge. Good specimens also exhibit a spine at the posterior extremity of the hinge not observed in *B. rugulosa*.

Occurrence.—Lower Cambrian (Hanfordian C1*b*): Kennebecasis River (*Aparchites robustus*); Upper Etcheminian, Indian Brook (*L. rugosa*); Lower Etcheminian, Dugald Brook (*B. perspicator magna* and *B. perspicator maxima*); Upper Etcheminian, Dugald Brook, Nova Scotia (*B. perspicator major*).

In the Etcheminian the species occur in divisions E1*b*–E1*d*, E2*a*, E2*b*, E3*d*–E3*f*. Walcott localities 10*p*, 10*p'*, 13*d*, 13*d'*, 13*n'*, 13*n''*, 13*t*, 13*t''*, 10*p*.

Plesiotypes.—Cat. Nos. 50517 (13*g*), 50518 (13*d*), U.S.N.M.

BRADORIA ROBUSTA LONGULA, new variety

Plate 2, Figure 5

A specimen in the Walcott collection from Dugald Brook indicates a species that, while readily distinguishable, is yet manifestly closely allied to *B. robusta*. The principal difference is the greater length of its cardinal margin; but as this peculiarity imparts a strikingly different outline to the valves, it is thought to be of importance. Unfortunately we have seen but a single specimen, and therefore can not say how constant these peculiarities may be. The surface markings are of the concentric pattern found in *B. robusta* and *B. rugulosa*.

Occurrence.—Lower Cambrian (Lower Etcheminian, div. E1*b*): Dugald Brook, Cape Breton, Nova Scotia (locality 13*t*).

Holotype.—Cat. No. 81379, U.S.N.M.

BRADORIA TONTOENSIS, new species

Plate 3, Figure 20

Of this species but a single specimen, a right valve, has been discovered. It is, however, very readily distinguished from all the other species of the group so far known by its outline and particularly by the obsolescence of the ocular node. This latter feature casts some doubt upon the generic reference; but as all the other features of the valve seem to be in harmony with the genus, the species may provisionally at least be fittingly placed here. Compared with other species of *Bradoria* we note considerable resemblance to such forms as *B. robusta* and *B. ovalis*. From both, however, it is at once distinguished by its more sharply defined cardinal angle and by the relatively greater height. From *B. robusta* it is further distinguished by the more nearly vertical anterior edge and the greater fullness of the posterior ventral part of the outline.

Occurrence.—Middle Cambrian (Bright Angel shale): Near mouth of Bass Canyon, Grand Canyon of the Colorado, Ariz.

Holotype.—Cat. No. 81377, U.S.N.M.

BRADORIA PERSPICATOR (Matthew) s. s.

Plate 1, Figures 6–9; Plate 3, Figure 12

Bradorona perspicator MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 444, pl. 1, figs. 8*a*–8*d*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 156, pl. 12, figs. 8*a*–8*d*.

Bradorona observator MATTHEW, s. s. Canadian Record Sci., vol. 8, 1902, p. 448, pl. 1, figs. 15*a*–15*c*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 160, pl. 12, figs. 15*a*–15*c*.

There are four specimens marked as types of *Bradorona perspicator* all doubtless conspecific. One, marked "A," the original of Matthew's figures 8*a*, 8*b*, and 8*c*, is the best preserved and therefore considered as the real type of the species. The original figures are accurate except in representing the ventral outline more sharply rounded than it is in the specimen and in giving the valve greater thickness (one-third more) in the edge views than we think it possesses. The ocular tubercle also is rather nearer the hinge than shown in the figure. *Bradorona observator*, s. s., is regarded as conspecific, and *B. spectator* a closely allied species, differing chiefly in having a somewhat coarser surface network.

In the Matthew's collection, seven specimens are called types of *Bradorona observator*. All of these seem to be merely young examples of *Bradoria perspicator*, and it is important to note that the types of the two so-called species are all from the same locality and bed (Lower Etcheminian, E1D, Boundary Brook, Nova Scotia). The surface pitting is fine and the same in both sets of types, and the outline and contour of valves precisely the same except that in the smaller examples (*B. observator* s. s.) the postcardinal angle or spine is less developed than in the larger examples (*B. perspicator* s. s.). It is a singular fact that the types of the three species, *spectator*, *perspicator*, and *observator*, are much nearer each other than any of the three is to the so-called mutations of the last.

Matthew's figure of *B. observator* (like that of *B. perspicator*) is too narrowly rounded at the middle of the ventral edge; i. e., this part of the outline is more produced in the illustration than in the original.

Occurrence.—Lower Cambrian (Lower Etcheminian, division E1*d*, E2*a*, E2*b*): Boundary Brook, Escasonie, Cape Breton. Walcott locality 10*p*, 13*d*″, Dugald Brook, Nova Scotia.

Plesiotype.—Cat. No. 50532, U.S.N.M. (13*d*″).

BRADORIA SPECTATOR (Matthew) s. s.

Plate 1, Figure 19

Bradorona spectator MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 447, pl.1, figs. 12*a*–*d*; Geol. Surv. Canada, Rep. Cambrian Rocks, Cape Breton, 1903, p. 158, pl. 12, figs. 12*a*–*d*.

The types of this form indicate such close relations to *B. perspicator* s. s. that we feel justified in doubting they can be successfully distinguished as species. Both forms are Lower Etcheminian and found at the same locality, namely, Boundary Brook. The selected types of the two differ slightly in size of surface punctation and a little in shape, *B. spectator* being somewhat less triangular and proportionately

higher. Matthew's figure is too full in the postventral region, and the postcardinal angle, which should be more, as in Figure 6, is not sufficiently brought out.

In the Matthew collection eight specimens are labeled types of *B. spectator*. Only two of these have the coarser network regarded as the principal feature distinguishing the species from its nearest allies. All of the other six specimens, when in condition to determine at all, are the same as the types of *B. perspicator* and its synonym *B. observator* s. s.

Occurrence.—Lower Cambrian (Etcheminian, division E1*c*, E1*d*, E2*l*, E3*e*); Boundary Brook, Nova Scotia. Walcott locality, 10*p*. (Dugald Brook).

Cat. No. 50530 U.S.N.M. (10*p*).

BRADORIA SPECTATOR SPINOSA (Matthew)

Plate 1, Figures 20, 21

Bradorona spectator mut. *spinosa* MATTHEW, Canadian Rec. Sci., vol. 8, 1902. p. 448, pl. 1, figs. 13 *a*, *b*; Geol. Surv. Canada, Rep. Cambrian Rocks, Cape Breton, 1903, p. 159, pl. 12, figs. 13 *a*, *b*.

Bradorona spectator mut. *aequata* MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 448, pl. 1, figs. 14 *a*, *b*; Geol. Surv. Canada, Rep. Cambrian Rocks, Cape Breton, 1903, p. 160, pl. 12, figs. 14 *a*, *b*.

Mutations *spinosa* and *aequata* are identical, the peculiarities supposed to distinguish them being greatly exaggerated in the figures and disappearing after a little cleaning of the specimens. The somewhat greater development of the postcardinal spine distinguishes the variety from the typical form of *B. spectator* and the closely allied *B. perspicator*.

Occurrence.—Lower Cambrian (Lower Etcheminian, E1*e*, *spinosa*, and E3*d*, *aequata*): Dugald Brook, Cape Breton.

BRADORIA CURTA, new species

Plate 3, Figure 10

This interesting new species represents an extreme in the genus in the length of its hinge line and the corresponding apparently greater width of the valve.

The ocular node is little developed, but otherwise the right valve upon which the species is founded has all the characters of *Bradoria*. In spite of its narrow hinge line the outline of the valve shows the five unequal sides characteristic of the genus.

Occurrence.—Lower Cambrian (Etcheminian, division E3*a*): Dugald Brook, Cape Breton, Nova Scotia (*loc.* 13*l'*).

Holotype.—Cat. No. 50547, U.S.N.M.

BRADORIA OBESA (Matthew)

Plate 1, Figure 27; Plate 3, Figure 13

Bradoria vigilans MATTHEW (part), Bull. Nat. Hist. Soc. ,New Brunswick, No. 18, 1899, p. 205; Canadian Record Sci., vol. 8, 1902, p. 454; Geol. Surv. Canada, Rept. Cambrian Rocks, Cape Breton, 1903, p. 164.

Bradoria vigilans mut. *obesa* MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 455.

A single specimen only is marked as representing this supposed mutation of *Bradoria vigilans*. As stated above in the remarks on that species, we find that three of the specimens labeled *B. vigilans* are really in every respect like the type of the mutation *obesa*. Further, we find these four specimens so constant in their characters and so readily distinguished by their shorter and more obese form, and even finer surface punctae, from the figured typical specimens of *B. vigilans* that we can not hesitate to regard them as specifically distinct. The outline of the valves of *B. obesa* is considerably like that of *B. perspicator* and *B. spectator*, differing only in being a trifle more obtuse in the ventral and anterior parts, but the ocular tubercle is so much better defined and the carapace so much thicker that there should be little difficulty in distinguishing them. In the last feature the species is allied to *B. cambrica*, in which, however, the ocular tubercle is much less developed.

Occurrence.—Lower Cambrian (Etcheminian, division E1*b*–E1*d*, E2*b*, E3*d*): Dugald Brook, Cape Breton, Nova Scotia. Walcott locality 13*n*″, 10*p*″.)

Cat. Nos. 50528, 50529, U.S.N.M.

"SCHMIDTELLA? PERVETUS" Matthew

Plate 1, Figure 26

Schmidtella (?) *pervetus* MATTHEW, Bull. Nat. Hist. Soc., New Brunswick, No. 18, 1899, p. 206, pl. 4, figs. 3*a*–*c*; Canadian Rec. Sci., vol. 8, 1902, p. 464, pl. 2, figs. 11*a*–*c*; Geol. Surv. Canada, Rep. Cambrian Rocks, Cape Breton, 1903, p. 172, pl. 13, figs. 11*a*–*c*.

As noted under the discussion of *Bradoria concinna*, the type of *Schmidtella*(?) *pervetus* Matthew was so poorly preserved as to be indeterminable, but the type of *S. pervetus* mutation *concinna* proved to be a valid species of *Bradoria*. Under the circumstances it seems best to recognize *Bradoria concinna* and to drop the name *Schmidtella? pervetus*.

Occurrence.—Lower Cambrian (Upper Etcheminian, division E3*e*): Dugald Brook, Cape Breton, Nova Scotia.

BRADORIA CONCINNA (Matthew)

Plate 3, Figure 9

Schmidtella(?) pervetus mut. *concinna* MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 464; Geol. Surv. Canada, Rept. Cambrian Rocks, Cape Breton, 1903, p. 173.

The "mutation" *concinna* was founded on a single specimen. It was in a good state of preservation, but required cleaning to bring out all of its characters. As now developed, the ocular tubercle is shown to be very slightly developed, and this feature serves very well in distinguishing the species from the otherwise closely similar *Bradoria spectator spinosa*. The ocular tubercle is not perfectly preserved nor is the antero-cardinal angle complete in the type, but both are satisfactorily shown in a specimen belonging to the Walcott collections. Comparing the species as known by these two specimens with *Bradoria spinosa*, *B. concinna* is smaller, slightly longer transversely, its dorsal angles less produced, the dorsal slope a trifle fuller, and the surface ornament perhaps a shade coarser than in *B. spinosa*.

The type of *Schmidtella? pervetus* being too poorly preserved to be determinable, it is suggested to raise the supposed variety *concinna* to the rank of a species and to drop the name *pervetus*.

Occurrence.—Lower Cambrian (Lower Etcheminian, division Elc, Eld): Boundary Brook, Escasonic, Nova Scotia. (Walcott locality 13*t*.'') Dugald Brook, Nova Scotia.

Cat. No. 50510 U.S.N.M. (13*t*'').

BRADORIA CAMBRICA (Matthew)

Plate 1, Figure 10; Plate 3, Figures 14, 15

Schmidtella cambrica MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 137, pl. 7, figs. 10*a*, 10*b*.

In its outline the type of this species, is much like *Bradoria spectator* and even more like *B. obesa*. It is smaller, however, and its ocular node less developed. From the former it differs considerably in having the central part of the valves much more elevated. *B. obesa* approaches it in this respect, but *B. cambrica* is a trifle shorter and has coarser surface punctation. *B. concinna* is longer transversely.

Matthew's type of *S. cambrica*, when figured and described by him, did not exhibit an ocular tubercle, but it shows clearly enough now since the obscuring matrix has been removed.

Occurrence.—Lower Cambrian (Hanfordian, division Clb3): Hanford Brook, St. Martins, New Brunswick. (Walcott locality 2*i*.)

Plesiotype.—Cat. No. 50533, U.S.N.M. (2*i*).

BRADORIA MINOR (Matthew)

Plate 1, Figure 22

Leperditia(?) minor MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 138, pl. 8, figs. 4*a*, 4*b*.

A single specimen represents this species. It is partly exfoliated, and the preservation of the posterior edge is not wholly satisfactory, but enough is retained to prove the systematic position of the species to be within the genus *Bradoria*. It agrees with *B. scrutator* in surface pitting and in the position and degree of development of the ocular tubercle, but differs in the outline of the valves, these being shorter and relatively broader anteriorly. Further, the contour of the valve (a left valve) differs in being less uniformly convex, the surface of the valve being obscurely conical and sloping in every direction from a subcentral apex. In its general aspect, *B. minor* resembles also *B. rugulosa* and *B. obesa*, and it it thought to be nearer the last than to any other known.

Occurrence.—Lower Cambrian. (Hanfordian, division C*l*b3): Hanford Brook, New Brunswick.

BRADORIA? STEADI (Matthew)

Plate 1, Figure 23

Leperditia steadi MATTHEW, Trans. Royal Soc. Canada, vol. 7, sect. 4, 1890, p. 160, pl. 7, figs. 13*a*–13*c*; Trans. New York Acad. Sci., vol. 14, 1895, p. 137, pl. 8, figs. 7*a*–7*c*.

No specimens of this species are present in the collection, but judging from the figures and description only it differs from *Bradoria minor* in little save size, being at least twice the width of that form. While it may be seriously questioned whether this is a valid specific difference, it is impossible to determine the point without specimens. Besides, *Leperditia steadi* may prove to be something very different, though that it should belong to *Leperditia* seems extremely improbable. In the meantime it is thought safer to remove it to *Bradoria*.

Occurrence.—Lower Cambrian (Hanfordian, division C*l*b): Hanford Brook, New Brunswick.

BRADORIA "PRIMAEVA" (Matthew)

Plate 1, Figure 29

Beyrichia (?) primaeva MATTHEW, Trans. Royal Soc. Canada, ser. 2, vol. 4, sect. 4, 1898, p. 133, pl. 1, figs. 2*a*–2*c*.

The specimen marked as the type of this species is an imperfect mold of the exfoliated exterior of a left valve. It is evidently a species of *Bradoria*, but with the material in hand it would not be safe to suggest alliances. As it is impossible to identify the species, the name should be dropped.

Occurrence.—Lower Cambrian (Hanfordian, division C*l*b2): Hanford Brook, New Brunswick.

BRADORIA? ORNATA Matthew

Plate 1, Figure 24

Bradoria(?) ornata MATTHEW, Canadian Record Sci., vol. 8, 1902, p. 456, pl. 2, figs. 4*a*–4*c;* Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 166, pl. 13, figs. 4*a*–4*c*.

This also is represented by a single example too poor to be definitely placed. No part of the margin is complete, and so far as preserved there is nothing to distinguish it from *B. scrutator* or *B. oculata*. The type being unidentifiable, the name should be dropped.

Occurrence.—Lower Cambrian (Lower Etcheminian, division Elc): Dugald Brook, Escasonie, Cape Breton.

BRADORIA? AURORA (Matthew)

Plate 1, Figure 28

Primitia aurora MATTHEW, Trans. Royal Soc. Canada, vol. 11, sec. 4, 1894, p. 98, pl. 17, figs. 5*a–c;* Trans. New York Acad. Sci., vol. 14, 1895, p. 136, pl. 8, figs. 1*a–c*.

Bradoria(?) aurora MATTHEW, Bull. Nat. Hist. Soc. New Brunswick No. 18, 1899, p. 204 (gen. ref.); Canadian Rec. Sci., vol. 8, 1902, p. 452.

Original description.—Suboval, elongate, nearly straight along the back, somewhat narrow towards the anterior end, flattened along the hinge line, and turned towards the ventral margin. There is a short broad vertical furrow at the anterior edge of the hinge line, whose length is about one-third of the whole length of the valve.

Sculpture.—This consists of closely set pits, just visible to the naked eye.

Size.—Length about 4 mm; width about 2 mm; height of valve about 1¼ mm. Matthew's type was not present in his collection when studied by us, so that we have to leave the status of the species uncertain.

Occurrence.—Lower Cambrian (Hanfordian, Cl*b*1): Hanford Brook, New Brunswick.

BRADORIA FENNICUS (Wiman)

Plate 3, Figure 17

Aparchites fennicus WIMAN, Bull. Geol. Inst. Upsala, vol. 6, pt. 1, 1902, p. 46, pl. 3, fig. 51.

The illustration of *Aparchites fennicus* Wiman as reproduced on Plate 3 certainly shows the relationship of the species to American forms like *Bradoria scrutator* and *B. benepuncta*.

Occurrence.—Cambrian (gray quartzitic sandstone): Åland, Sweden.

BRADORIA NITIDA (Wiman)

Plate 3, Figure 16

Bradorona nitida WIMAN, Bull. Geol. Inst. Upsala, vol. 6, pt. 1, 1902, p. 48, pl. 1, figs. 34, 36, 37.

The illustration of the type of *Bradorona nitida* Wiman, reproduced on Plate 3, indicates that it belongs to *Bradoria* and is not unlike certain of the American species.

Occurrence.—Cambrian sandstone: Island of Åland, Sweden.

BRADORIA HICKSII (Jones)

Plate 3, Figure 4

Leperditia hicksii JONES, Quart. Journ. Geol. Soc. London, vol. 28, 1872, p. 183, pl. 5, fig. 16; Ann. Mag. Nat. Hist., ser. 5, vol. 8, 1881, p. 346, pl. 20, fig. 6.

As figured this species seems to be allied most closely to *B. vigilans*, differing from it chiefly in the slight elevation of its ocular tubercle. It constitutes, indeed, a very inconspicuous feature in this species, while in *B. vigilans* it is a very prominent one. The proportion of height and length is different, the height being relatively greater. Finally the posterior outline is much more broadly rounded.

Occurrence.—Middle Cambrian (Menevian): St. Davids, Wales.

Genus WALCOTTELLA, new genus

Carapace bivalved, subovate, 3 to 7 mm. in length, hinge straight, rather long. Valves moderately convex, usually with a more or less prominent, conical eminence situated in the median third of the length and occasionally one or two much less conspicuous nodes near the antero-dorsal angle. Edges of valves thin, bordered, gaping anteriorly and posteriorly. Test phosphatic, thin, pliable, closely punctate exteriorly.

Genotype.—Walcottella apicalis, new species.

This genus is named after the late Dr. Charles D. Walcott, to whose acumen and diligence science is indebted for the splendid collection of Cambrian fossils in the United States National Museum. All of the species so far known of this genus were procured by him from the late Middle Cambrian Bright Angel shale in the Grand Canyon of the Colorado in Arizona.

The thirteen species brought together under the above generic designation, though exhibiting a considerable range of variation, seem yet to constitute a natural association. The most variable and at the same time the most obvious of the generic characters is the submedian eminence. In *W. apicalis* and *W. concentrica* it is situated very near the center of the valves. In *W. breviuscula*, according to the adopted orientation of the valves, this eminence is well behind the middle, but in all of the remaining species it tends to move

anteriorly. Except *W. ventrosa*, in which it is situated relatively farther forward than in the others, the variability in position with respect to the middle of the valves would seem to be largely accounted for by variation in the proportionate lengths of the anterior and posterior halves. Regarding the eminence as an approximately fixed point, and taking into account the matter of size of valves, the proportional distance from its apex to the anterior edge is much less variable than is the distance to the posterior edge. Hence, when the valve is elongate, as in *W. oblonga*, *W. longula*, *W. limatula*, and *W. scitula*, the apex is more or less anterior of the middle. On the contrary, when the valve is relatively short, the apex is near the middle or behind that point.

A rather disconcerting fact is notable in *W. leperditoides*, *W. nitida* and *W. obsoleta*. In these species, namely, the median eminence is barely distinguishable or quite obsolete. After close study, however, it has seemed indisputable that the first two are still close allies of *W. pulchella* and *W. apicalis*, while the last can not be far removed from *W. oblonga*.

Respecting the morphological significance of the surface nodes of *Walcottella*, the small elevation frequently observable in the anterocardinal angle is thought to be the homologue of the similarly placed node in *Bradoria*, and of the "eye tubercle" in *Leperditia* and *Isochilina*. The larger median eminence doubtless corresponds to the "muscle spot" of the Ordovician and Silurian Leperditiidae and not to the more ventrally situated but otherwise similar spine found in the group of *Isochilina* typified by *I. armata*. The relations suggested are further strengthened by the striking similarity in general aspect presented by *W. leperditoides* and *W. nitida* to average examples of *Leperditia*. Were it not for the obvious differences in the substance and other features of their respective shells, it would be difficult to point out convincing reasons for classifying these two Cambrian species under *Walcottella* and not *Leperditia*.

Compared with other Cambrian genera of bivalved Crustacea, it is at once distinguished from *Bradoria* by the median eminence. Comparing certain species of each genus, essential agreement in general outline is noted, but the more typical species of *Bradoria* exhibit obtuse angulations in the anterior and posterior parts of their outlines—sometimes also in the ventral part—that do not occur in *Walcottella*. Matthew's genus *Indiana*, as herein defined, is probably also related, but the total absence of surface nodes in that group of species is a sufficiently obvious distinction to render confusion between them unlikely. It might occur only in comparing forms like *Walcottella leperditoides* and the associated *Indiana faba*. Another useful, though perhaps not very important, difference is observed in studying the outer surface of the shell. In *Walcottella*,

namely, the surface is always distinctly and closely pitted. In *Indiana*, on the contrary, the surface is always at least smooth and generally polished, the punctae, which are usually present, being very small and distant.

The relations of *Walcottella* to *Aluta* Matthew, as redefined by the writers, are probably much less than may appear on first thought. *Aluta* often has a small node in the anterior half of the valves that may suggest the median tubercle of a *Walcottella* like *W. limatula*. On further study the node in the former is recognized as representing the "ocular node" and not the "muscle spot." The test of *Aluta* also is quite different, being thinner, smooth, and almost membranous. Finally, the general shape is different, the valves having a more decided retral swing and the antero-cardinal angle being sharper and the most prominent part of the anterior margin. In fact, *Aluta* is believed to represent another family and to be much more closely allied to the new genus *Dielymella* than to *Walcottella*.

WALCOTTELLA APICALIS, new species

Plate 4, Figures 1, 2

Description.—Carapace subovate, slightly oblique, widest posteriorly; length and height respectively about as 4 is to 3 or 5 to 4; hinge straight, rather long, about three-fourths of the total length; antero-cardinal angle sharp, 100° to 110°; postcardinal angle distinct but much wider, about 130°; excepting the cardinal edge and small parts just beneath its extremities, the outline forms a nearly regular elliptic curve. Surface of valves depressed conical, sloping at first sharply and then more gradually, though not uniformly, in all directions from the apex of the strong, centrally situated conical eminence; slope to the cardinal edge more concave than to the ventral margin. A wide, flattened border, very distinct on the right valve but scarcely defined on the left, extends around the free edges. Two low ridges usually distinguishable in the space between the median tubercle and the antero-cardinal angle. The anterior of these two ridges is the longer and may be recognizable halfway down the anterior side. The inner swelling, which probably embraces the "eye spot," is flanked on either side by an ill-defined depression. Surface of shell closely punctate, or rather reticulate, the pattern, as to size and arrangement of punctae about as in *W. breviuscula*. (See pl. 4, fig. 5.) A tendency to concentric arrangement of the punctae is occasionally observable in the middle part of surface.

Dimensions of an average example: Length 5 mm.; greatest height, 4 mm.; thickness between apices of median nodes estimated at nearly 5 mm.

In its outline this species resembles *W. breviuscula* and *W. leperditoides*, but is distinguished at once by the much greater strength and prominence of its median tubercle.

Occurrence.—Middle Cambrian, sandstone beds in the Bright Angel shale just above the massive lower bed, near mouth of Bass Canyon, Kwagunt Valley, and Chuar Valley, Grand Canyon, Ariz.

Cotypes.—Cat. Nos. 56477, 56478, U.S.N.M.

WALCOTTELLA CONCENTRICA, new species

Plate 4, Figures 3, 4

Description.—Carapace comparatively small, broadly subovate, the outline, except for the short and not sharply defined hinge line, approximately circular. As a rule one side, thought to be posterior, is somewhat narrower and longer than the other. Surface of valves somewhat depressed convex to the base of the but slightly eccentric, strong conical tubercle; or the whole surface may slope away from the apex with little change in angle. The specimens present no indication of smaller anterior nodes, nor is there any satisfactory evidence of a flattened border. Surface of shell rather coarsely punctate, the punctae elongate and so arranged that they suggest interrupted concentric wrinkles.

Dimensions of an average carapace: Length 3.0 mm.; greatest height 2.5 mm.; thickness between apices of median tubercles about 2.5 mm.

Remarks.—This species, besides being smaller than the others is readily distinguished by its nearly circular valves and the concentrically arranged and wrinklelike pitting of the surface. When exfoliated it is not so easily separated from the young of *W. apicalis*, to which it is doubtless also closely allied. The collection contains eight specimens.

Occurrence.—Bright Angel shale, Bass Canyon and Chuar Valley Grand Canyon of the Colorado, Ariz. Associated with the preceding.

Cotypes.—Cat. Nos. 56479, 56480, U.S.N.M.

WALCOTTELLA BREVIUSCULA, new species

Plate 4, Figures 5, 6

Description.—Carapace of medium size, subovate; hinge line two-thirds the greatest length, straight, the anterior extremity sharply angular, the posterior angle more obtuse; ends nearly equal, the anterior slightly the narrower and less curved in the upper part of its outline. Valves moderately convex, the slope of the rounded surface clearly distinguished from the base of the conical median tubercle. This, though a prominent feature, is smaller than in *W. apicalis* and *W. concentrica*, and is situated well behind the center, provided the smaller end is really the anterior. Ocular and other nodes indistin-

guishable. Surface of shell distinctly puncto-reticulate, the pattern as coarse as in any and obviously coarser than in most of the other species. No well-defined flattened marginal border.

Dimensions of the best specimen, a left valve: Greatest length, 4.5 mm.; greatest height, 3.5 mm.; thickness (one valve), about 1.4 mm.

Remarks.—In deciding that the smaller of the two ends is the anterior in this species, the judgment of the writers has been based chiefly on the fact that in nearly all bivalved crustacea having a straight hinge, the antero-cardinal angle is sharper than the posterior; and when the outline is oblique with respect to the hinge line, the "swing" is backward. Relying on these criteria, the median tubercle is situated behind the middle of the valves, an arrangement that serves well in distinguishing the species from all the others now referred to the genus. Aside from this peculiarity, *W. breviuscula* resembles *W. pulchella*, the principal other differences being that the ends are less unequal in width and the surface ornament coarser in the present species. In *W. apicalis* the apex of the median tubercle is slightly in front of the middle, low ridges are recognizable in the anterio-cardinal region, and the slope of the surface of the valves from the apex to the margins more suggestive of the uniform grade of a depressed cone.

Occurrence.—Bright Angel shale, Bass Canyon, Grand Canyon of the Colorado, Ariz. Two specimens only found. Associated with the preceding.

Cotypes.—Cat. No. 56481, U.S.N.M.

WALCOTTELLA SCITULA, new species

Plate 4, Figure 7

Description.—Carapace somewhat elongate, obliquely subovate, with long, straight hinge, beginning rather abruptly at the anterior end but passing much more gradually into the semicircular curve of the posterior margin; anterior end considerably narrower than the posterior. Surface of valves rather strongly convex, rising from the margins with first a convex, then a nearly uniform depressed conical slope to the apex. The summit is located a little in front of the middle, does not rise abruptly in profile, but is marked by a smooth space. Ventral part of margin not preserved, but that remaining on the ends seems not to have been provided with a flattened border. Ocular node not developed. Surface of shell puncto-reticulate, the pattern in the median area tending to a concentric arrangement of the punctae about the smooth apical spot.

Dimensions of the unique type specimen: Greatest length, 4.7 mm.; greatest height, about 3.0 mm.; greatest thickness, left valve only, about 1.2 mm.

Remarks.—The ventral margin of the type specimen is imperfect. As restored in our photographic illustration, it resembles *W. pulchella*, but is still too elongate for that species. The antero-cardinal angle also is different, while the median tubercle of the latter is more prominent and pointed and situated farther anterior. Finally, *W. pulchella* has smaller and closer punctae. *W. scitula* probably also is related to *W. apicalis*, but the median tubercle of the latter is so much stronger that confusion between them is very unlikely. Imperfect specimens of *W. oblonga* might be confused, but complete examples are readily distinguished by their oblong, equal-ended shape.

Occurrence.—A single left valve only was found associated with the preceding species in the Bright Angel shale at Bass Canyon, Grand Canyon of the Colorado, Ariz.

Holotype.—Cat. No. 56482, U.S.N.M.

WALCOTTELLA PULCHELLA, new species

Plate 4, Figures 11, 12

Description.—Carapace egg-shaped, decidedly narrower in front than behind, greatest height and greatest length, respectively, as 2 is to 3; hinge rather short, only five-eighths of the greatest length, the two extremities obtusely angular and more nearly equal than usual; valves gaping distinctly at the ends and probably also a little along the ventral margin; edges of valves with a thin, wirelike rim. Surface of valves rather strongly convex; flattening along free margins inconspicuous; median tubercle small but prominent, pointed, its apex located about one-tenth of the length of the carapace anterior to the middle; eye node apparently not distinguishable. Surface of shell very finely puncto-reticulate.

Dimensions of type specimen: Length 4.0 mm., greatest height 2.7 mm.; greatest thickness, between apices of median tubercles, 2.3 mm.

Remarks.—This neat species resembles *W. ventrosa* and *W. limatula* but is easily recognized by its simple border, greater convexity, and different outline. It is really more closely allied to *W. leperditoides*, *W. scitula*, and *W. apicalis*. From all of these it is distinguished by the finer pattern of its surface network. Compared further with each, the first is larger and without a well-defined median tubercle, the second is more elongate and has a less pointed node, while the third has a larger tubercle and conical rather than convex valves.

Occurrence.—The figured specimen only has been seen. This was broken out of a block of the same bed of the sandstone in the Bright Angel shale from which most of the species of this genus were procured by Walcott at his locality in Bass Canyon, Grand Canyon of the Colorado, Ariz.

Holotype.—Cat. No. 56483, U.S.N.M.

WALCOTTELLA LEPERDITOIDES, new species

Plate 4, Figure 8

Description.—Carapace leperditoid in shape, the outline with respect to the long and straight hinge being somewhat oblique, the cardinal angles, especially the anterior, well defined, the upper part of the end margins straight, and the ventral half of the outline semiovate. The surface of the valves rises to a subcentral, broadly rounded apex, the slope toward the ends nearly uniform and toward the dorsal and ventral edges slightly convex. A slight flattening, barely visible even in favorable lighting, occurs along the free margins. Excepting a considerable space about the apex, the surface of the shell is distinctly puncto-reticulate.

Dimensions of a good left valve: Greatest length 6.2 mm., greatest height 4.2 mm., greatest thickness about 1.9 mm.

Remarks.—Were it not for the white, phosphatic shell of this fossil, it might be difficult to remove the impression of close relationship to *Leperditia* that is at once suggested by its general aspect. This impression, however, is quickly invalidated by the shell structure, which is exactly the same as in the other species of *Walcottella* and contrasts strongly in color, probable chemical composition, and minute surface markings, with that prevailing among the true Leperditiidae from their first appearance in the Beekmantown to the last at the close of the Silurian. That it is not a *Leperditia* is further indicated by the free edges which surely never overlapped in the ventral part. In every essential feature, except the median tubercle, which is practically obsolete, *W. leperditoides* agrees with *W. pulchella*, and that species is most certainly not a close ally of the much later Leperditiidae. That the latter were derived out of *Walcottella* is thought highly probable, but the differences between the known forms of the two types are at least of family importance.

Compared with other species of *Walcottella*, the obsolescence of the median tubercle serves readily in distinguishing *W. leperditoides* from those simulating it in other respects.

Occurrence.—Same as the preceding.

Holotype.—Cat. No. 56484, U.S.N.M.

WALCOTTELLA NITIDA, new species

Plate 4, Figures 9, 10

Description.—Carapace broadly subovate, hinge long, straight, the cardinal angles clearly defined, the anterior one especially sharp; ends not very unequal, the posterior slightly the wider and more uniformly curved at the margin than the anterior, the front outline slightly concave in the upper third; ventral half of outline a nearly regular though broad semiellipse. The right valve figured on Plate 4 is the only

specimen seen. It is clean cut but largely exfoliated and retains small patches of the delicate white exterior layer of the shell only along the margins. Except along the anterior side there is no evidence of a flattened border, but on the internal cast an impressed line follows the ventral edge and marks off a narrow band. The surface is rather strongly convex, reaching its greatest elevation a short distance in advance of the middle of the valve in a low, conical, radially marked eminence representing the median tubercle of the other species of the genus. Between this elevation and the antero-dorsal angle is a smaller but more sharply defined node regarded as the ocular tubercle. Just in front of this and extending downward parallel with the anterior edge, a shallow furrow. Surface of shell puncto-reticulate, the pattern and size of punctae about as in *W. breviuscula*, figured on the same plate. The punctae extend through the outer into the inner layer of the shell.

Dimensions of the type specimen, a right valve: Length 4.8 mm., greatest height (across the posterior half) 3.2 mm., greatest thickness about 1.3 mm.

Remarks.—The general aspect of this valve is highly suggestive of certain species of *Isochilina*, an Ordovician and Silurian genus of Leperditiidae. However, for essentially the same reasons mentioned in discussing the resemblance of *W. leperditoides* to *Leperditia*, the evidence is convincing that in this case also the resemblance is not based on true affinity. An ocular node and the shallow anterior furrow are both present in *W. apicalis*, but the median tubercle is so much stronger in that species that, while their generic alliance seems assured, their specific relations can not be very intimate. Both *W. pulchella* and *W. leperditoides* probably are nearer allies, but neither of these has an ocular tubercle.

Occurrence.—Sandstone bed in Bright Angel shale, Bass Canyon, Grand Canyon of the Colorado, Ariz.

Holotype.—Cat. No. 56485, U.S.N.M.

WALCOTTELLA OBLONGA, new species

Plate 5, Figure 8

Description.—A right valve only has been observed, and this is imperfect in the posterior and ventral half of the outline. So far as preserved and interpreted, the carapace is oblong or subcylindrical with rounded ends, the hinge line straight, long, the anterior angle obtuse but well defined, the posterior angle more indefinite, the ventral side gently convex and approximately parallel to the hinge. Surface rather strongly convex, the median tubercle not very conspicuous and situated its diameter in advance of the middle of the valve. The eye node is barely distinguishable and the puncto-

reticulate ornament of the shell somewhat coarser than that of *W. limatula* and a grade finer than in *W. scitula* and *W. breviuscula.*

Dimensions of the type specimen: Greatest length 3.8 mm., greatest preserved height 2.0 mm., probable height of perfect valve, about 2.3 mm., thickness of single valve about 0.9 mm.

Remarks.—Despite the imperfections of the unique example upon which this species is based, its preserved characteristics seemed sufficiently peculiar and indicative of the complete form to justify its description. If correctly understood, the species is allied to *W. scitula* and *W. obsoleta,* being in fact an intermediate form. Better specimens of all three of these species are necessary before their relations may be accurately determined.

Occurrence.—Sandstone in Bright Angel shale, Bass Canyon, Grand Canyon of the Colorado, Ariz.

Holotype.—Cat. No. 56486, U.S.N.M.

WALCOTTELLA OBSOLETA, new species

Plate 4, Figure 13

Description.—Only a single specimen, thought to be a right valve, is known of this species. The curvature of the dorsal and ventral slopes is unusually abrupt. This fact, together with apparent imperfections of both the posterior and anterior thirds of the cardinal edge, suggests that the specimen has suffered compression, causing it to appear more elongate than originally. This distortion probably affected the posterior half more than the anterior. It is believed that the normal form should be higher, possibly intermediate between what it is now and the restored figure of *W. scitula* on the same plate. Bearing this in mind, the species may be briefly characterized as follows: Carapace rather elongate, oblong to subrhomboidal, the height four-ninths to possibly three-fifths of the length; ends subequal, hinge straight, cardinal angles not very sharply defined, ventral margin gently convex. Surface strongly convex, the point of greatest prominence beneath and considerably in front of the middle; tubercles quite obsolete. Surface of shell with the usual punctate ornament; color yellowish white.

Dimensions of the specimen described: Greatest length, 5.5 mm., greatest height, 3.0 mm.; thickness of one valve about 1.3 mm.

Remarks.—The unique example on which this species is founded has precisely the same kind of shell as all of the other species referred to the genus. It can not, however, be claimed as a typical member of the genus, the entire obsolescence of the median tubercle and the unusual length being such obvious departures from the average forms of *Walcottella,* that its classification is necessarily attended with some doubt. Still in the matter of elongation, the present species barely exceeds *W. oblonga,* which doubtless is its closest known relative,

while in the matter of the reduction of the median tubercle, it is no worse off than *W. leperditoides*.

Occurrence.—Same as *W. apicalis*, *W. leperditoides*, etc., Bright Angel shale, Grand Canyon, Ariz.

Holotype.—Cat. No. 56487, U.S.N.M.

WALCOTTELLA LIMATULA, new species

Plate 5, Figures 1–3

Description.—Carapace subovate, wide posteriorly, narrow anteriorly, with a long straight hinge line and obtusely angular cardinal extremities; anterior margin most prominent in the upper third beneath which it recedes rapidly in the lower two-thirds; ventral margin rather strongly convex, its posterior third, together with the whole of the posterior outline to the extremity of the hinge, forming a uniform circular curve. Valves only moderately convex, the curvature of the surface, disregarding the nodes, almost uniform from end to end; free margins, when perfect, with a distinct, flattened border. When this border is broken away, as in Figure 1, on Plate 5, the form appears more elongate than normal. Main tubercle located about one-fifth of the length in advance, and slightly above the middle, strong, conical, conspicuously elevated above the general surface of the valve. Midway between this tubercle and the anterior extremity of the hinge is a much smaller, ocular node. Surface of shell very finely puncto-reticulate, the pattern smaller than in any of the preceding species except *W. pulchella*.

Dimensions of the type specimen: Greatest length 5.0 mm.; greatest height 3.2 mm., greatest thickness (between apices of main tubercles) 1.8 mm.

Remarks.—This seems to be the commonest of the species of the genus collected by Walcott at his locality in Bass Canyon, nine or ten specimens being confidently referred to it. While the species appears to be fairly constant, it may yet be observed that in some of the specimens the ventral part of the outline is less convex, the anterior extremity less narrowly curved, and the main tubercle a little stronger than in Figure 2 on Plate 5. Such a specimen is represented by the original of Figure 1 on the same plate. Possibly they constitute a recognizable variety.

Compared with other species of the genus, *W. limatula* is easily distinguished by the shape of its valves. Of those approaching it most in this respect, *W. ventrosa* will be found to be shorter and to have the ends more nearly equal in size and curvature of outline. *W. subtruncata* and *W. longula* also are closely allied but differ so obviously from *W. limatula* in the truncation and greater width of their anterior extremities, that comparison between them is not likely to occur.

Occurrence.—Bright Angel Shale, Grand Canyon, Ariz.

Cotypes.—Cat. No. 56488, U.S.N.M.

WALCOTTELLA VENTROSA, new species

Plate 5, Figures 4, 5

Description.—Carapace broadly elliptical, truncated by the hinge line; ends subequal, curving regularly into the convex ventral margin; cardinal angles obtuse, almost rounded. Surface of valves gently convex, the free edges narrowly rimmed. Main tubercle rather small but very sharply elevated, located almost in the middle of the antero-dorsal fourth. Midway between this and the cardinal angle a minute ocular node is barely distinguishable. Surface of shell minutely puncto-reticulate.

Dimensions of figured specimen, a right valve: Length 3.1 mm., height 2.2 mm., thickness about 1.0 mm.

Remarks.—This pretty species doubtless is closely allied to *W. limatula*. The principal difference lies in the outline which is more uniformly curved, the ends consequently being nearly equal, whereas in that species the posterior is the wider and the curvature of the margins of the ends quite different. *W. ventrosa* seems also to be a smaller species.

Occurrence.—Associated with *W. limatula* and most of the other species of the genus here described, in the Bright Angel shale, Bass Canyon, Grand Canyon, Ariz.

Holotype.—Cat. No. 56489, U.S.N.M.

WALCOTTELLA SUBTRUNCATA, new species

Plate 5, Figure 6

Description.—Carapace subquadrate, hinge straight, ventral edge moderately convex, ends, especially the anterior, obliquely truncated so that the greatest length lies well beneath the mid height; postero-ventral part of outline less abruptly curved than the corresponding part on the anterior side. Surface moderately convex, the flattened border narrow but well defined, the median tubercle of moderate size but conspicuously elevated, located one fifth the length in front of the middle of valve; two comparatively obscure nodes occur between the main tubercle and the antero-cardinal angle. Surface of shell minutely reticulated.

Dimensions of the type specimen: Greatest length 4.1 mm., length of hinge 3.2 mm., greatest height 3.0 mm., thickness of single (right) valve about 1.6 mm.

Remarks.—*W. subtruncata* is easily distinguished from all the preceding species of the genus by its quadrate form. The following *W. longula* alone resembles it in this respect.

Occurrence.—Same as *W. ventrosa*, *W. limatula*, and other species collected from the Bright Angel Shale at Bass Canyon, Grand Canyon, Ariz.

Holotype.—Cat. No. 56490, U.S.N.M.

WALCOTTELLA LONGULA, new species

Plate 5, Figure 7

This species is so much like the preceding *W. subtruncata* that a detailed description is unnecessary. The types of the two species agree in every essential respect except that *W. longula* is relatively more elongate, and that the tubercle is situated above instead of on the level of the middle of the valve. None of the other species of the genus is sufficiently like it to require comparisons.

Dimensions: Greatest length 5.0 mm., length of hinge 3.6 mm., greatest height 3.0 mm., thickness about 1.2 mm.

Occurrence.—Same as *W. subtruncata.*

Holotype.—Cat. No. 56491, U.S.N.M.

BEYRICHONIDAE, new family

Carapace bivalved with valves apparently fitting close together all around the edges, leaving no gap. Surface of valves with a depressed anterodorsal region bordered by variously arranged ridges or nodes. Shell structure black, calcareo-corneous.

Genus BEYRICHONA Matthew

Beyrichona MATTHEW, Trans. Royal Soc. Canada, vol. 3, sect. 4, 1886, pp. 64, 65.—MILLER, North Amer. Geol. and Pal., 1889, p. 535.—MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 133.—JONES, Geol. Mag., dec. 4, vol. 9, 1902, p. 402.

Escasona MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 457.—JONES, Geol. Mag., dec. 4, vol. 9, 1902, p. 402.—MATTHEW, Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 167. (Genotype: *E. rutellum* Matthew.)

The essential characters of the genus as founded on *Beyrichona papilio* and *B. tinea* are (1) the subtriangular outline of the valves, and (2) a broad, undefined depression in the dorsal slope. This depression is limited in front by a short, nodelike ridge paralleling and just within the upper third of the anterior border, and on the posterior side by a thinner and more angular ridge starting at the hinge near its posterior extremity and curving slightly forward to its terminus about the middle of each valve. The central part of the depressed space is more or less convex, the swelling being most pronounced and best defined in those species in which the relative height of the valves is least (as *B. triceps*). In species like *B. ovata*, and *B. rutellum*, in which the height reaches the opposite extreme, the mesial swelling is entirely obsolete. In the most typical species, a low ridge, growing obsolete posteriorly, begins at the antero-cardinal node and forms an irregular swelling along the cardinal edge. Usually a very narrow flattened border is developed along the free margins of the valves. Length of valves in various species 3 to 5 mm.

The genus as now known to us embraces four or five typical species and three or four varieties of these probably deserving separate names. Besides these we refer here the two recognizable species of *Escasona* Matthew, which we regard as congeneric.

Matthew referred four species to his proposed genus *Escasona*. One of these, *E. ovata*, he had previously described as a *Beyrichona*. The type of the proposed genus is *E. rutellum*. Both of these species differ from the more typical species of *Beyrichona* chiefly, if not solely, in the contraction of their horizontal dimensions and in the modification of the dorsal nodes and mesial depression incident to this shortening of the valves. In our opinion, *E. rutellum* probably and *B. ovata* certainly stand at one end, and *B. triceps* at the opposite extreme of the development of a single generic type of which *Beyrichona tinea* represents the typical or average expression.

The types of *Escasona ingens* and *E. vetus* are so imperfect that it is thought impossible to ever recognize other specimens of the species with certainty. It would be to the advantage of science, therefore, to drop these names, and with them *Escasona*, unless more complete collections should prove the advisability of retaining the name for *E. rutellum*.

BEYRICHONA PAPILIO Matthew

Plate 6, Figure 11; Plate 7, Figures 5–7

Beyrichona papilio Matthew, Trans. Royal Soc. Canada, vol. 3, sect. 4, 1886, p. 65, pl. 6, figs. 20, 20*a*, 20*b;* Trans. New York Acad. Sci., vol. 14, 1895, p. 134, pl. 7, figs. *4a–4c*.

Beyrichona triangula Matthew (part), Trans. New York Acad. Sci., vol. 14, 1895, p. 135, pl. 7, fig. 5.

This, the genotype, is founded on a single but good specimen showing two valves opened so that they lie in nearly the same plane. The ventral angle is prominent, acute, the posterior edge abruptly truncated, very slightly curved in outline and disposed at nearly a right angle to the hinge line. The nodes are well developed, the posterior one sharply ridged, differing thus from all the other species.

As will be noted presently, two of the types of *B. triangula* (pl. 7, figs. 6, 7) are of this species. Judging from the Walcott collection, the species is not common.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*2–C1*b*4): Hanford Brook, New Brunswick.

Plesiotype.—Cat. No. 50501, U.S.N.M. (10*c*. 2*i*).

BEYRICHONA TINEA Matthew

Plate 6, Figures 1, 2, 5–7; Plate 7, Figure 4

Beyrichona tinea Matthew, Trans. Royal Soc. Canada, vol. 3, sect. 4, 1886, p. 66, pl. 6, figs. 21, 21*a*, 21*b;* Trans. Royal Soc. Canada, vol. 11, sect. 4, 1894, p. 97; Trans. New York Acad. Sci., vol. 14, 1895, p. 134, pl. 7, figs. 6*a–6c*.

This is one of the more abundant species of this genus, and in its typical form is readily distinguished from *B. papilio* by the rounding of its ventral margin, its more erect—that is, less oblique—habit, and less angular posterior ridge. The short anterior and posterior dorsal ridges are well developed, and as compared with *B. planata* the posterior one is much better defined than usual in that variety or closely allied species. The five specimens in the Matthew collection marked types are all of the same form. Matthew's main figure of the species is accurate so far as outline is concerned, but is imperfect in representing the posterior ridge too narrow. The small oblique lines in the dorsal depression also are somewhat misleading.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*2–C1*b*4): Hanford Brook, New Brunswick.

Plesiotype.—Cat. No. 50549, U.S.N.M.

BEYRICHONA TINEA TRIANGULA (Matthew)

Plate 6, Figures 8–10; Plate 7, Figures 8, 9

Beyrichona triangula MATTHEW (part), Trans. New York Acad. Sci., vol. 14, 1895, p. 135, pl. 7, fig. 5 (see also *B. papilio*).

The three types of this form indicate two species. The specimen marked "A" represents a rather common variety of *B. tinea* in which the ventral portion is somewhat produced and hence more sharply rounded. The anterior edge also is blunter. Typical examples of this variety are readily distinguished, but in the Walcott collection there are so many intermediate specimens that we do not feel justified in according a higher rank to the form than that of a variety or mutation of *B. tinea*.

The other two specimens, marked "B" and "C," are unquestionable examples of *B. papilio*. The figure given by Matthew of *B. triangula* is manifestly a composite of the characters of two distinct species. Specimen A supplied the dorsal half, B and C the ventral part. In A the ventral extremity was obscured by adhering rock. When this was removed, the belief that this specimen, if not identical with *B. tinea*, was at least more closely allied to that species than to *B. papilio*, became strengthened to conviction, for it proved in every respect identical with a form that we had distinguished as a variety of *B. tinea*, and for which we propose to adopt Matthew's name.

Occurrence.—Lower Cambrian (Hanfordian-div. C1*b*3): Hanford Brook, New Brunswick.

Plesiotypes.—Cat. No. 50550, U.S.N.M. (*loc. 2'*).

BEYRICHONA TINEA PLANATA (Matthew)

Plate 6, Figures, 3, 4; Plate 7, Figures 1–3

Beyrichona planata MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 134, pl. 7, fig. 7.

This is represented in the Matthew collection by four specimens, three exactly alike, and one marked "B" proportionally longer on the hinge line, this difference causing the posterior edge to range something like 80° to the hinge line. In the other specimens, which bear the usual characters of the species or variety, this angle is very near 90°. Bearing this difference in mind, it appears that specimen B, which is also the largest and best preserved of the four, is the original of Matthew's Figure 7, on Plate 7, the specimen and figure agreeing exactly in the posterior half. The anterior half, however, shows differences, the figure being especially inaccurate in representing the antero-ventral part of the outline as much more convex than we find it in the specimen. His description says that the border is narrower but we failed to notice any difference in this respect when compared with *B. tinea*.

Concerning the relations of *B. planata* to *B. tinea*, the types of the two alone left no doubt as to their being very close. With the abundant material in the Walcott collection, the case became complicated by the finding of other slightly varying forms, all pointing, like *B. planata* to *B. tinea* as the central type of a variable species.

Variety C: Considering specimen B as the real type of the variety *planata*, the other three specimens, A, C, and D, would represent a second variety differing chiefly and probably solely in the more vertical disposition of the posterior edge. Both differ from *B. tinea* s. s. in the greater width of the cardinal portion of the slope from the summit of the anterior ridge to the edge of the valve; in other words, the anterior extremity of the carapace extends farther beyond the anterior node than in *B. tinea*. The greater width of this slope lends greater conspicuity to a low, generally undefined ridge that traverses it vertically. The corresponding rib is more obscurely indicated on the more abrupt anterior slope in *B. tinea*. As a rule the posterior node or ridge is less definitely developed in these varieties than in *B. tinea* but the difference is not constant.

Variety D: Another variety is represented by numerous but not very good examples in which the posterior margin is vertical as in the second variety above, but the anterior slope is abrupt as in *B. tinea*, while the postventral angle is sharply rounded as in the variety *triangula*. From the latter, as also from *B. tinea* s. s., it differs in its right-angled form, and in the comparative obsolescence of the posterior and median nodes.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*1–C1*b*3): Hanford Brook, New Brunswick.

Plesiotypes.—Cat. No. 50491, U.S.N.M.

BEYRICHONA ROTUNDATA Matthew

Plate 6, Figure 12; Plate 7, Figures 11, 12

Beyrichona rotundata Matthew, Trans. New York Acad. Sci., vol. 14, 1895, p. 136, pl. 7, fig. 9.

Represented in the Matthew collection by three specimens. Two of these, A and B, are alike, the third, C, not entirely clear of the matrix, seems to be a more triangular form than the other two, and probably is referable to *B. tinea*, or possibly the young of *B. tinea planata.*

Specimens A and B agree fairly well with Matthew's figure, except that the free border is scarcely so uniformly rounded as represented in the figure. As to the validity of the species, it is closely related to *tinea* and *planata*, differing from both in the lesser height of the valves and more uniformly curved ventral margin. Except that the sulci are deeper, the configuration of the dorsal half of *B. rotundata* corresponds in all essential respects with *B. tinea*, and differs, therefore, the same as that form, from *B. planata.* Possibly this form also is but a variety of *B. tinea*, but if the peculiarities shown in the types are fairly constant, it will be best to class it as closely allied but specifically distinct.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*2, C1*b*3): Hanford Brook, New Brunswick.

Plesiotype.—Cat. No. 50500 U.S.N.M.

BEYRICHONA TRICEPS (Matthew)

Plate 6, Figures 13–15

Beyrichia triceps Matthew, Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 219, pl. 16, figs. 4*a*–4*c*.

Though resembling the Silurian genus of Ostracoda in general aspect, this species is no more a *Beyrichia* than are the other Bradoriidae and Beyrichonidae. The type specimens are all more or less imperfect, but between them they leave no doubt in our minds that the species belongs strictly to *Beyrichona.* In essential features it differs from the typical species solely in being relatively elongate. The nodes, especially the central one, are somewhat stronger in *B. triceps*, but this is to be expected as a natural result of the vertical shortening.

The greater the proportionate height (see *Escasona*) the less distinctly developed are the nodes.

The species, as judged from a large number of specimens in the Walcott collection, is rather variable in the relative proportions of height and length.

Occurrence.—Middle Cambrian (Johannian, division C2*b*): McLean Brook, near Marion Bridge; Dugald Brook; and 1.5 miles west of Marion Bridge, Cape Breton, Nova Scotia.

Plesiotypes.—Cat. No. 50502-50504, U.S.N.M. (3*i*, 10*s*, 13*g*).

BEYRICHONA OVATA Matthew

Plate 7, Figure 10

Beyrichona ovata MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 135, pl. 7, fig. 8.

Escasona ovata MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 458 (gen. ref.)

The original type of this species (it is accompanied by a second specimen too poorly preserved to be identified) is a *Beyrichona* with an extremely short hinge. On account of this shortening of the carapace, the median dorsal depression is very narrow, and, being deep, the central swelling observed in the more typical species is entirely obsolete. The antero-cardinal node, however, is as in *B. tinea*, while the parts in which it differs are behind this node, hence in those portions of the carapace which the variations in the more typical species of the genus show to be comparatively unstable. In short, while *B. ovata* is a well marked and good species, it is yet a *Beyrichona*. Matthew's figures are fairly accurate.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*2): Hanford Brook, New Brunswick.

BEYRICHONA FABA Wiman

Plate 7, Figure 17

Beyrichona faba WIMAN, Bull. Geol. Inst. Upsala, vol. 6, pt. 1, 1902, p. 47, pl. 3, fig. 52.

Although imperfect the type specimen of *Beyrichona faba*, judging from the original illustration here reproduced closely approaches in outline certain American species such as *B. tinea planata* Matthew.

Occurrence.—Lower Cambrian, Olenellus bituminous sandstone: Limön near Gefle, Sweden.

BEYRICHONA GEVALENSIS Wiman

Plate 7, Figures 14–16

Beyrichona gevalensis WIMAN, Bull. Geol. Inst. Upsala, vol. 6, pt. 1, 1902. p. 46, pl. 1, figs. 29, 30, 35.

Wiman's figures are so similar to American species like *B. tinea* that there can be no doubt of the correct reference of this species to *Beyrichona*.

Occurrence.—Lower Cambrian, Olenellus bituminous sandstone: Biludden, Sweden.

BEYRICHONA ALTA Wiman

Plate 7, Figure 13

Beyrichona alta WIMAN, Bull. Geol. Inst. Upsala, vol. 6, pt. 1, 1902, p. 47, pl. 3, fig. 53.

The type and only specimen is an imperfect valve, but according to the figure of it published by Wiman it clearly represents an elongate species of *Beyrichona*.

Occurrence.—Lower Cambrian, Olenellus bituminous sandstone: Limön near Gefle, Sweden.

BEYRICHONA? RUTELLUM (Matthew)

Plate 1, Figure 32; Plate 3, Figure 21

Escasona rutellum MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 458, pl. 2, figs. 5*a*–5*c*; Geol. Surv. Canada, Rept. Cambrian Rocks Cape Breton, 1903, p. 167, pl. 13, figs. 5*a*–5*c*.

Depending solely upon the original type of this species, *B. rutellum* appears to be a short hinged form in which the essential features of *Beyrichona* are recognizable only in a subdued condition; that is, they are somewhat obscurely developed. The hinge is considerably shorter than the height, the dorsal depression is smaller and less defined than usual, and the antero-dorsal node, as well as the sulcus immediately behind it, less distinctly developed. Still, all these features of *Beyrichona* are so clearly recognizable that generic separation seems undesirable. On the other hand, it is not to be denied that the surface pitting and general aspect of the valve is not greatly different from species of *Bradoria* like *B. cambrica*. Possibly with more specimens (we have seen only Matthew's original) it may be shown that the affinities of the species are really nearer *Bradoria* than *Beyrichona*. In that case *Escasona* might stand, but in no case should it include *Beyrichona ovata*, which also has an unusually short hinge.

Occurrence.—Lower Cambrian (Etcheminian, division E3*f*): Gillis, Indian Brook, Cape Breton, Nova Scotia.

DOUBTFUL SPECIES

ESCASONA INGENS Matthew

Plate 1, Figure 31

Escasona (?) *ingens* MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 459, pl. 2, figs. 7*a*–*c*; Geol. Surv. Canada, Rep. Cambrian Rocks Cape Breton, 1903, p. 168, pl. 13, figs. 7*a*–*c*.

The single specimen bearing this name, hence the type, is so indefinitely preserved that it would be unsafe to venture an opinion.

Occurrence.—Lower Cambrian (Coldbrookian): Dugald Brook, Nova Scotia.

ESCASONA VETUS Matthew

Plate 1, Figure 33

Escasona(?) vetus MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 458, pl. 2, figs. 6*a*, *b*; Geol. Surv. Canada, Rep. Cambrian Rocks Cape Breton, 1903, p. 168, pl. 13, figs. 6*a*, *b*.

The only specimen bearing this label is also too imperfect to justify description. It presents obscure resemblance to *E. rutellum*, but the pitting of its surface is of a coarser pattern. It is recommended that this name and the preceding be dropped as unrecognizable.

Occurrence.—Lower Cambrian (Lower Etcheminian, division E1*d*): Boundary Brook, Nova Scotia.

Genus SELLULA Wiman

Sellula WIMAN, Bull. Geol. Inst. Upsala, vol. 6, pt. 1, 1902, p. 48.

This genus is evidently related to *Beyrichona*, differing in that the surface of the valve is concave with a thin ridge along the anterior and posterior borders and the middle part of the anterior extremity is produced into an obtuse angulation. A narrow border is present along the post ventral part.

Genotype.—*Sellula fallax* Wiman.

SELLULA FALLAX Wiman

Plate 7, Figures 18, 19

Sellula fallax WIMAN, Bull. Geol. Inst. Upsala, vol. 6, pt. 1, 1902, p. 48, pl. 1, figs. 31, 32.

The characters of this the genotype and only species are given in the remarks upon the genus.

Occurrence.—Lower Cambrian, Olenellus bituminous sandstone: Biludden, Sweden.

Genus ALUTA Matthew, emended

Aluta MATTHEW, Trans. New York Acad. Sci., vol. 15, 1896, p. 198.—MILLER North Amer. Geol. and Pal., App. 2, 1897, p. 786.

Leperditia FORD (not Rouault), Amer. Journ. Sci., ser. 3, vol. 6, 1873, p. 138.—WALCOTT, Bull. No. 30, U. S. Geol. Surv., 1886, p. 146; Amer. Journ. Sci., ser. 3, vol. 34, 1887, p. 193; 10th Ann. Rep. U. S. Geol. Surv., 1890, p. 628.

Aristozoe WALCOTT (not Barrande), Amer. Journ. Sci., ser. 3, vol. 34, 1887, p. 193; 10th Ann. Rep. U. S. Geol. Surv., 1890, p. 627.

Bradoria WALCOTT (not Matthew), Proc. U. S. Nat. Mus., vol. 29, 1905, p. 99.

Description.—Carapace bivalved, 2 to 10 mm. long; valves apparently closing all around, leaving no gaps, obliquely acuminate-subovate in outline, narrow and acuminate anteriorly, broad and rounded posteriorly, straight along dorsal side; antero-dorsal angle sharp, often produced, 90° or less; posterior angle more obtuse, sometimes

rounded off; surface moderately convex, usually depressed in the antero-dorsal region; beneath this depression and generally near the lower part of the anterior edge a conspicuous though variable node or ridgelike swelling; anterior, ventral and posterior margins with a flattened border, usually widest anteriorly and sometimes excavated on the inner side. Test thin, black, corneous, pliable, smooth or punctate exteriorly.

Genotypes.—*Aluta flexilis* Matthew (original) and *Aristozoe troyensis* (Ford) Walcott.

Remarks.—The above definition aims to be a composite of the characters noted in studying the following 8 or 10 species. Together they form a reasonably compact group distinguished from all others by the form of the carapace and more especially by the node in the antero-ventral fourth. This node varies considerably in position and development, but it does not get far enough out of its normal position to suggest comparison with the ocular node in *Bradoria*. In the latter the node is strictly confined to the dorsal region of the valves; in *Aluta*, on the contrary, it must be counted a feature of the antero-ventral part.

After cleaning the original type of Matthew's *Aluta flexilis*, it was found that he had figured it upside down, and that the outline of the specimen, instead of being regularly oval, was really obliquely acuminate oval. It has a comparatively short but straight hinge line and well-defined cardinal angles. As now understood, its outline is not greatly different in essential respects from *A. stereope* (Walcott) and *A. subrotunda* (Walcott). Certainly there is not sufficient difference in their respective outlines to warrant generic separation.

Unfortunately, the type of *A. flexilis* is a specimen so crushed that it is impossible to prove that it was originally provided with a node. The specimen is thought to consist of both valves, which, fitting closely and consisting of a pliable substance, constituted a baglike carapace that collapsed when it was subjected to the pressure of the entombing sediments. The Chinese *A. fragilis* (Walcott) is founded on similarly crushed specimens. However, the irregularities of the surface of the type of *A. flexilis* probably are not altogether accidental, the elevation between the large and two smaller depressions in the anterior part of the specimen possibly corresponding to the characteristic node. Believing that the specimen on which Matthew founded his genus *Aluta* really did have such a node, and as it agrees in all other generic respects with the other species here referred to the genus, it seemed a better plan to redefine *Aluta* than to confine it to *A. flexilis* and erect a new generic group for the other more fully known species.

Considered individually the species of *Aluta* indicate rather diverse alliances. Thus the smaller forms, like the Chinese *A. woodi* and

A. bergeroni, are greatly like *Lepiditta*, the principal, or rather most striking difference being the antero-ventral node which is wanting in the latter genus. The dorsal depression which is usually present in *Aluta* likewise is absent in that genus. *A. rotundata* suggests very different affinities, namely with *Beyrichona*. In fact, in the lobation of the valves this species is so highly suggestive of that genus that the resemblance is believed to be indicative of true genetic relationship. Further, if the hinge of *A. rotundata* were longer, the postcardinal angle narrower, and the outline less oblique, this species would probably have been referred to *Beyrichona*, as has already been suggested by Matthew,[3] rather than *Aluta*. Finally, most of the species of *Aluta* recall the much larger forms comprised in the genus *Dielymella*. That genus is, of course, distinguished readily enough by its gaping valves and its evenly convex surface contours, there being no sign of either the antero-ventral node or the dorsal depression generally found in *Aluta*. Still, when the latter is absent, as in *A. troyensis*, it is difficult to escape the conviction that some genetic relation exists between the two genera. Two of the species, *A. troyensis* and *A. rotundata*, were referred by Walcott[4] to *Aristozoe*. While presenting a general resemblance to that remarkable Silurian genus of Phyllocarida, or of Phyllopoda, there should be little doubt that these Cambrian bivalved crustaceans belong to a very distinct genus. Compared with *Aristozoe*, these differ not only in being much smaller but in the more important fact that their valves close tightly all around instead of being curved so as to gap widely at the ends. Compared further they are found to differ in the general outline of the valves, in having a dorsal depression, and in the more antero-ventral position of the node or nodes. Finally the shell differs in being thinner, more flexible, and less calcareous in composition. In the position of the nodes *Aluta* is like *Callizoe*, another Silurian genus described by Barrande; but as that genus is generally regarded as related to *Aristozoe*, there is probably no direct alliance between it and *Aluta*.

Viewed as a genus, *Aluta* can not very well be classified except as an aberrant member of the family Beyrichonidae. The type differs from *Polyphyma*, *Beyrichona*, and *Hipponicharion*, the three other more typical members of the family, in the comparative brevity of its hinge and particularly in the reduction of the postdorsal angle. The latter feature is responsible for the prevailing obliquity of its outline, in which respect *Aluta* agrees with some of the Bradoriidae.

[3] Trans. New York Acad. Sci., vol. 14, 1895, p. 133.

[4] Amer. Journ. Sci., ser. 3, vol. 34, 1887, p. 193; 10th Ann. Rep. U. S. Geol. Surv., 1890, p. 628.

ALUTA FLEXILIS Matthew

Plate 8, Figures 13, 14

Aluta flexilis MATTHEW, Trans. New York Acad. Sci., vol. 15, 1896, p. 198, pl. 15, fig. 4.

Description.—Carapace acuminate-subovate, oblique, narrow, and angular in front, wide and rounded behind; hinge rather short, anterior extremity rectangular, postdorsal angle obtuse. Surface features obscured by crushing of valves. A well-defined border beginning at the antero-dorsal angle extends downward around the anterior and ventral sides but is apparently lost on the posterior side. Greatest diameter about 4.0 mm.

Remarks.—Only a single specimen of this species is known. This is the original of Matthew's description and figure of the genus and species and is now preserved in the museum of the University of Toronto. As already mentioned, further preparation of the specimen resulted in proving that it has a straight hinge and is acuminate anteriorly instead of regularly elliptical in outline. As now understood, *A. flexilis* comes so near to certain Chinese species recently described by Walcott that it is difficult to point out satisfactory differences. Thus *A. fragilis* (*Bradoria fragilis* Walcott), which also is founded on crushed examples, differs only in being smaller and in certain minor peculiarities of its outline. Chief among the latter differences is that the hinge is longer in the Chinese species, its posterior margin being more nearly vertical than in *A. flexilis*. In *A. eris*, *A. stereope*, and *A. woodi*, three other small Chinese species of the genus published by Walcott, the posterior outline is more in accord with that of *A. flexilis*. Each of these species, however, is distinguished by slight differences in the anterior parts of their outlines. On account of the crushing of the valves of *A. flexilis*, it is not possible to say whether its surface characters were materially different or not.

Occurrence.—Middle Cambrian, Acadian division of St. John group, division C1c1, Porter's Brook, St. Martins, New Brunswick.

ALUTA BERGERONI (Walcott)

Plate 8, Figures 3, 4

Bradoria bergeroni WALCOTT, Proc. U. S. Nat. Mus. vol. 29, 1905, p. 99.
Aluta bergeroni WALCOTT, Research in China, Carnegie Institution, vol. 3, 1913, p. 225, pl. 23, fig. 10.

Description.—Carapace obliquely semielliptical, narrow and acuminate anteriorly, broadly rounded posteriorly, hinge straight, nearly as long as the length of the valve; antero-dorsal angle sharp, 80° or less; post-dorsal angle somewhat obtuse, 100° or more. Surface rather strongly convex, the most prominent point a little behind and above the middle; dorsal slope more abrupt than the ventral. Node

small but distinct, rounded, located a little nearer the hinge line than the anterior extremity; from base of node a delicate ridge extends toward the antero-dorsal angle. Dorsal depression not well defined, small, confined to the area above the node and ridge. Marginal rim clearly defined, of moderate width, thick, flattened on the inner and outer faces. Except for a few shallow scattered pits that may be accidental, the surface of the shell appears smooth under a hand lens. Under a high power of magnification it shows exceedingly minute punctae.

Dimensions: Length of valve 1.8 mm., greatest height 1.00 mm., depth about 0.5 mm.

Remarks.—The unique left valve on which this species is based is readily distinguished from all the other species referred to the genus providing its present form is normal for the species. The fact that the dorsal edge of the valve is turned strongly inward so that in a view of the posterior edge the inner line of the profile is concave instead of straight, is highly suggestive of distortion. If the present form of the valve is normal, then the concavity of the edges indicates a wide gap between the valves such as is entirely unknown in the otherwise similar species with which *A. bergeroni* is associated. If, on the contrary, it is admitted that the extraordinary incurvature of the back is due to distortion, it will be found, when the easily effected restoration of the original form has been made, that the normal outline is almost the same as in *A. eris* and *A. stereope*. With the limited material available for comparison, it is impossible to establish either of these two suppositions. Under the circumstances it would be unfair to take a more decided stand than to say that the latter interpretation is thought the more likely to accord with the facts. Further, it should be said that the normal form of *A. bergeroni* is probably more nearly like that of *A. eris* and *A. stereope* than is indicated by the figures of the three forms given on Plate 8. Finally, a second specimen, unfortunately imperfect anteriorly, agrees closely in all its remaining parts with the probable normal form of *A. bergeroni*.

Occurrence.—Middle Cambrian; compact, bluish gray, thin-bedded limestones; from shingle on gravel bar in the Lan Ho, 1 mile south of Chen Ping Hsien, southeastern Shensi, China.

Holotype.—Cat. No. 56493, U.S.N.M.

ALUTA ERIS (Walcott)

Plate 8, Figure 1

Bradoria eris WALCOTT, Proc. U. S. Nat. Mus., vol. 29, 1905, p. 100.
Aluta eris WALCOTT, Research in China, Carnegie Institution, vol. 3, 1913, p. 226, pl. 23, fig. 12.

Description.—Carapace obliquely acuminate subovate, broadly rounded posteriorly, narrowing anteriorly; hinge about three-fourths

the length of valve, straight, forming an angle of about 80° with the nearly straight anterior edge; postdorsal angle obtuse. Surface moderately convex, with an ill-defined, broad depression in front of the middle of the dorsal slope and three nodelike elevations about it. The largest and roundest of the nodes is located at the base of the depression and somewhat nearer the antero-ventral edge of the valve than the middle of the dorsal edge. A thin ridge extends from this node toward the antero-dorsal angle and about midway between the two points the specimen shows part of the base of the second node rising from the ridge. Dorsal parts of specimen imperfect but showing the remains of a third small elevation near the middle of the dorsal edge. Marginal rim sharply defined, thick and convex on the anterior side, much thinner and comparatively indistinct (perhaps imperfect) on the posterior side. Under a strong lens the surface of the test is covered with shallow punctae.

Dimensions of a right valve: Length about 2 mm., height about 1.5 mm., depth about 0.5 mm.

Remarks.—The original type and only known specimen of this species has been slightly crushed and is imperfect in its dorsal and posterior parts. Judging from what may be seen, the species appears to be closely related to the associated *A. enyo* (Walcott) and *A. woodi* (Walcott). In the former the anterior edge is more nearly vertical, and the anterior half on the whole wider. A more important difference perhaps is that *A. enyo* is without the node at the base of the dorsal depression. In *A. woodi* all three nodes are indicated, but the anterior one and the lower one are both less developed, while the thin ridge connecting them is prolonged posteriorly in a looplike extension over the central part of the valve.

Occurrence.—Middle Cambrian; compact, bluish-gray, thin-bedded limestone; from shingle on gravel bar in the Lan Ho, 1 mile south of Chen Ping Hsien, southeastern Shensi, China.

Holotype.—Cat. No. 56496, U.S.N.M.

ALUTA ENYO (Walcott)

Plate 8, Figures 5, 6

Bradoria enyo WALCOTT, Proc. U. S. Nat. Mus., vol. 29, 1905, p. 99.
Aluta enyo WALCOTT, Research in China, Carnegie Institution, vol. 3, 1913, p. 225, pl. 23, fig. 11.

Description.—Carapace quadrangular, subovate, truncated along the hinge line, broadly rounded on the posterior and ventral sides, vertical at the front edge; antero-dorsal angle sharp, about 90°; postdorsal angle more obtuse. Surface rather tumid in the posterior two-thirds, depressed in the median part of the antero-dorsal quarter. Principal (? ocular) node small, rounded, located slightly beneath and in front of the middle of the antero-dorsal fourth. A double-

headed small elevation close to the middle of the dorsal edge. Marginal rim narrow but sharply defined and uniform in development. Surface of shell very minutely punctate, appearing smooth under an ordinary hand lens.

Dimensions of type, a left valve: Length 1.0 mm., height about 0.75 mm., depth about 0.25 mm.

Remarks.—Only a single, well preserved left valve of this species has been found. It is the smallest of all the known Cambrian bivalved Crustacea. Perhaps it is a young example. Assuming that it is mature and retains its normal characteristics, the species is readily distinguished from the preceding *A. eris* and *A. bergeroni* by its more quadrangular shape. The former species is further differentiated by having a third (antero-ventral) tubercle, while in *A. bergeroni* the antero-dorsal depression is less conspicuous, and both are represented by larger specimens than *A. enyo*. The type of *A. stereope* is similarly of small size and is thought to be its closest ally. Indeed, the most striking difference between the types of *A. enyo* and *A. stereope*, namely, certain oval depressions in the anterior half of the latter that are not seen in the former, may really be due to accidental causes.

Occurrence.—Middle Cambrian; compact, bluish gray, thin-bedded limestone; from shingle on gravel bar in the Lan Ho, 1 mile south of Chen Ping Hsien, southeastern Shensi, China.

Holotype.—Cat. No. 56497, U.S.N.M.

ALUTA STEREOPE (Walcott)

Plate 8, Figures 9, 10

Bradoria stereope WALCOTT, Proc. U. S. Nat. Mus., vol. 29, 1905, p. 101.
Aluta stereope WALCOTT, Research in China, Carnegie Institution, vol. 3, 1913, p. 226, pl. 23, fig. 14.

Description.—Carapace small, obliquely acuminate-subovate in outline, the rectangular antero-dorsal part suggesting the quadrangular; hinge straight, about three-fourths as long as the valve, terminating sharply in front, less abruptly behind; posterior and ventral sides rounded. Surface of valve rather strongly convex, rising to the greatest height near the middle. A thin ridge, beginning at the antero-dorsal angle, extends inward about half the distance to the middle of the valve, where it terminates in a small tubercle. Four dentlike depressions, arranged somewhat symmetrically with respect to the ridge, and possibly of accidental origin, occur in the antero-dorsal half of the valve. One of these lies in the triangle between the ridge and the dorsal edge, a second, large and elliptic in shape, stretches half the distance from the tubercle to the postdorsal angle. The other two depressions occupy most of the space between the lower side of the ridge and the anterior margin. Marginal rim

sharply defined, rather narrow, apparently double, with an extremely delicate accessory flange on its outer edge. Surface of shell appearing smooth and polished, minutely punctate when magnified about 15 diameters.

Dimensions of type, a right valve: Length 1.1 mm., height about 0.8 mm., depth about 0.26 mm.

Remarks.—The original type and only known specimen of this species seems in an excellent state of preservation. The only possible exception to this condition is found in the dentlike depressions of the surface. These look too much like accidental indentations of the pliable shell to be accepted unqualifiedly without the corroborative evidence of other specimens. That there is good ground for suspicion is shown by a specimen of *A. woodi* having similar indentations but still recognizable by the characteristic loop of that species. Should they prove normal structures, they would afford unusually striking criteria in the determination of the species. If, on the other hand, they could be shown to be abnormal, it would practically eliminate all differences of any consequence between *A. stereope* and *A. enyo*. However, until the validity of the differences on which the separation of the two species is based can be determined, they should be recognized as distinct.

Occurrence.—Middle Cambrian; a fine-grained, bluish-black limestone bowlder believed to have come from the lower part of the Ki-sin-ling limestone, collected in river drift 1 mile south of Chon-p'ing-hien, on the Nan-kiang River, southern Shensi, China.

Holotype.—Cat. No. 56498, U.S.N.M.

ALUTA WOODI (Walcott)

Plate 8, Figures 7, 8

Bradoria woodi WALCOTT, Proc. U. S. Nat. Mus., vol. 29, 1905, p. 102.
Aluta woodi WALCOTT, Research in China, Carnegie Institution, vol. 3, 1913, p. 227, pl. 23, fig. 15.

Description.—Outline of carapace obliquely acuminate-ovate, truncated along the hinge line, rather broadly rounded behind and below, the anterior side oblique, straight or slightly concave and drawn out somewhat beaklike at the anterior extremity of the hinge; postdorsal angle rather well defined, the hinge line and upper part of posterior margin making an angle of about 120°. Marginal rim distinct, of moderate width. Surface of valves rather strongly convex in the middle and posterior parts, depressed on either side of a low, mid-dorsal elevation. The principal characteristic is a thin, curved ridge, beginning at the anterior extremity and extending obliquely backward and downward to a point consideraly behind the center of the valve. Here it turns on itself and forms a loop inclosing a large median relatively depressed elliptical space. Two small nodes

occur on this ridge, one at the anterior end of the loop, the other larger and somewhat crescentic in shape, about midway between the middle of the valve and the anterior extremity of the hinge. Surface very minutely punctate under a strong lens.

Dimensions of original type, a left valve: Length 2.0 mm., height 1.25 mm., depth about 0.5 mm.

Remarks.—The specimen used by Walcott in describing this species is in an unusually good state of preservation. The outline differs somewhat from that of all other species referred to the genus, but the principal and most striking peculiarity is the long curved ridge which traverses the anterior and middle parts of the valve. A second specimen, discovered in the course of these studies, and satisfactorily identified with this species by its outline and the presence of the looped ridge, has several indentations of the surface that are entirely absent in the type specimen. These indentations are comparable with those marking the surface of *A. stereope* and being clearly abnormal in the case of *A. woodi*, strongly suggest a similar origin for the other as well.

Occurrence.—Middle Cambrian; a fine-grained, bluish-black limestone bowlder believed to have come from the lower part of the Ki-sin-ling limestone, collected in river drift 1 mile south of Chon-p'ing-hien, on the Nan-kiang River, southern Shensi, China.

Holotype.—Cat. No. 56494, U.S.N.M.

ALUTA FRAGILIS (Walcott)

Plate 8, Figure 2

Bradoria fragilis WALCOTT, Proc. U. S. Nat. Mus., vol. 29, 1905, p. 100.
Aluta fragilis WALCOTT, Research in China, Carnegie Institution, vol. 3, 1913, p. 226, pl. 23, fig. 13.

Original description.—"Hinge line nearly straight, about one-fifth shorter than the width of the valve. Posterior cardinal angle obtuse, with the marginal curve long and passing into the broad curve of the lower end of the valve; anterior cardinal angle about 75°, with the anterior margin nearly straight to where it merges into broad curve of the lower part of the valve.

"Surface of the valve wrinkled to such an extent that it looks like wrinkled parchment. What may be an ocular tubercle occurs a short distance from the hinge and anterior margin. Surface minutely punctate under a strong lens.

"Width [length], 2.25 mm.; length [height], 2 mm.; depth unknown, as the flexible test has been compressed."

Remarks.—The type of this species is so badly crushed that satisfactory comparisons with the other species can not be made. The outline even may not be exactly preserved. Assuming that it is nearly normal in the type specimen, the outline may be described as essentially like that of *A. woodi* and *A. eris*. Similarly crushed carapaces

are not uncommon in the limestone holding this and the other Chinese species of *Aluta*. They exhibit considerable variation in form, but to what extent this is attributable to distortion can not be determined. Some of them doubtless belong to one or another of the associated species, all of which are of smaller diameter than the type of *A. fragilis*. Assuming that the dimensions are fairly constant for each species, only the larger examples are provisionally referred to this species.

Compared with American species, *A. fragilis* appears to be closely allied to the genotype, *A. flexilis* Matthew. Aside from the fact that the Chinese species is only about half as large, it differs chiefly, so far as the characters are known, in having a longer hinge.

Occurrence.—Middle Cambrian limestone, found loose on a gravel bar on the Nan-kiang River, 1 mile south of Chon-p'ing-hien, southern Shensi, China. Pieces of the same limestone, found on the same gravel bar, contained *A. enyo*, *A. eris*, *A. bergeroni*, *A. stereope*, and *A. woodi*; also fragments of a trilobite suggesting *Dorypyge*.

Holotype.—Cat. No. 56495, U.S.N.M.

ALUTA TROYENSIS (Ford)

Plate 8, Figures 15–17

Leperditia troyensis Ford, Amer. Journ. Sci., ser. 3, vol. 6, 1873, p. 138.—Walcott, Bull. No. 30, U. S. Geol. Surv., 1886, p. 146, pl. 16, fig. 5.

Aristozoe troyensis Walcott, Amer. Journ. Sci., ser. 3, vol. 34, 1887, p. 193, pl. 1, fig. 8; 10th Ann. Rep. U. S. Geol. Surv., 1890, p. 628, pl. 80, figs. 2, 2*a*.

Description.—Carapace large for the genus, obliquely subtriangular in outline, acuminate anteriorly, rounded on the postventral side; dorsal side long, slightly arcuate; anterior angle about 65° to 70°, postdorsal angle more obtuse but well defined, about 115°. Surface only moderately convex, without distinguishable depressions, highest in the anteroventral part where it rises into a large blunt spine or conical elevation. Marginal rim wide, convex, best defined on the anterior side, where a corresponding concavity on the inner side of the shell produces a narrow but distinct marginal ridge on casts of the interior. The latter show further that the main cavity of the shell is prolonged anteriorly to the extremity of the hinge and that the dorsal edge is much thicker in its anterior half than in its posterior part. Shell comparatively thick and firm in the anterior part, but otherwise apparently as in other species of the genus.

Dimensions of a left valve: Greatest diameter 7.5 mm., greatest height 5.0 mm., thickness about 1.5 mm.

Remarks.—This species is readily distinguished from all the preceding species of the genus by its greater size, firmer shell, subtriangular form, slightly arcuate dorsum, and anteroventral node. These differences might possibly warrant generic separation, but after

careful consideration it was decided to extend the limits of *Aluta* so that it might properly receive the species. While this arrangement may not be altogether satisfactory, it is certainly a more natural position than was assigned the species by Ford, who placed it under *Leperditia*, and later by Walcott, who referred it to *Aristozoe*.

Occurrence.—Limestone in shaly slates belonging in upper part of Lower Cambrian, on ridge east of the city of Troy, N. Y.; also one-half mile west of North Greenwich, Washington County, N. Y.

Plesiotype.—Cat. No. 17447, U.S.N.M.

ALUTA PRIMORDIALIS (Linnarsson)

Plate 8, Figures 11, 12

Leperditia primordialis LINNARSSON, Kongl. Sven. Vet.-Akad. Handl., vol. 8, No. 2, 1869, p. 84, pl. 2, figs. 65, 66.

Leperditia (*Isochilina*), *primordialis* LINNARSSON, Ofvers. K. Vet.-Akad. Forhandl., vol. 26, 1869, p. 196; 1875, vol. 32, pp. 15, 18, 33, 34, 37, 45.

"*Leperditia*" *primordialis* WALLERIUS, Unders. Zonen med Agnostus laevigatus i Vestergotland, Lund, 1895, p. 62.—GRONWALL, Danmarks Geol. Unders., II Taekke, No. 13, 1902, p. 162.

This Swedish species is known to the authors from numerous excellent specimens which show that the species can not belong to the Leperditiidae, the presence of an antero-ventrally situated node being altogether foreign to any member of that family of Ostracoda. The species agrees in the form of its carapace and especially in the position of the main tubercle, with American Cambrian species of Phyllopoda here referred to *Aluta*. Though easily distinguished, the taxonomic value of the differences, so far as they can be determined is not greater than specific. The truth of this statement will be apparent when the photographic copies of Linnarsson's original figures on Plate 8 are compared with the figures of *A. troyensis* and *rotundata* on the same plate.

Compared with *A. troyensis*, *A. primordialis* is distinguished by its less acuminate, relatively blunt, anterior extremity, less produced postventral margin, by the extension of the marginal rim around the postdorsal angle, the greater convexity of the valves, and finally by having a dorsal furrow that is not present in *A. troyensis*. In some of these features the Swedish species agrees better with *A. rotundata*, but the dorsal depression is much narrower, the antero-ventral node much more prominent and not ridgelike, the convexity of the valves greater, and the general form more elongate. The length, as given by Linnarsson, is 8.0 mm., the height 5.0 mm.

Occurrence.—Middle Cambrian, Olenidskiffer of Linnarsson, at several localities in the province of Vestergotland, Sweden.

ALUTA ROTUNDATA (Walcott)

Plate 8, Figures 18, 19

Aristozoe rotundata WALCOTT, Amer. Journ. Sci., ser. 3, vol. 34, 1887, p. 193, pl. 1, fig. 9; 10th Ann. Rep. U. S. Geol. Surv., 1890, p. 627, pl. 80, fig. 3.

Original description.—"General outline of the valves subrotund, with the exception of the nearly straight hinge line; anterior end slightly narrower than the posterior; general surface rather strongly convex, marked all around, except along the hinge line, by a strong marginal groove within a rounded marginal rim; a single elongate protuberance extends from the main body of the shell upward, just within the anterior marginal groove and the hinge line, where it is most prominent, and separated from the main body of the valve by a broad sulcus extending from the hinge line down on the valve over two-fifths the distance to the ventral margin.

"The shell is thin and apparently very finely granulose [more likely punctate]."

Dimensions of the original type: Length 5.5 mm., height 4.0 mm. depth (both valves) 1.9 mm.

Remarks.—The specimen described by Walcott is the only one so far seen of this interesting species. It retains both valves, which, excepting that they are slightly displaced, are in good condition. The test is thin, black, very slightly calcareous, and apparently lamellose; hence liable to exfoliation. In composition and structure it is essentially the same as the shell of *A. troyensis*, of *Walcottella*, *Dielymella*, *Beyrichona*, and most of the other bivalved Crustacea described in this work. For this and other reasons mentioned in the remarks on the genus *Aluta*, *A. rotundata* and *A. troyensis* have been removed from *Aristozoe* and *Leperditia*, to which they have been previously referred. The close relations of *A. rotundata* to *Beyrichona* also are discussed in the generic remarks.

Viewed in its specific relations, *A. rotundata* is closely comparable only with *A. troyensis* and *A. primordialis*, though readily distinguished from both. From the former it differs in many particulars, the most striking and important of these being (1) the large depression in the antero-dorsal quarter, of which no sign is observable in that species, and (2) its rounded rather than triangular shape. It is nearer *A. primordialis*, but the outlines of the two forms are scarcely less different, while the depressions and elevations in the anterior half are so obviously different in arrangement and degree of development that it is unnecessary to point out the several disagreements.

Occurrence.—Lower Cambrian; limestones interbedded in the shaly slates on M. C. Tefft's farm, about 2 miles southeast of North Greenwich, Washington County, N. Y.

Holotype and *plesiotype.*—Cat. No. 17446, U.S.N.M.

ALUTA DOUVILLEI (Mansuy)

Plate 4, Figure 17

Bradoria douvillei MANSUY, Mem. Service Geol. l'Indo-Chine, vol. 1, 1912, p. 22, pl. 1, fig. 8.

Judging from the illustration, part of which is reproduced in Plate 4, this species belongs to *Aluta* and is related to species from China with distinct cardinal angles. The crushing of the valves so common in species of *Aluta* is also shown in Mansuy's figure.

Occurrence.—Cambrian, associated with *Redlichia chinensis*, between Yi-Léang and Ko-Pao-Tsouen, eastern Yunnan.

ALUTA HOLLII (Jones)

Plate 8, Figure 33

Beyrichia hollii JONES, Geol. Mag., n. ser., dec. 2, vol. 8, 1881, p. 343, pl. 10, fig. 7.

This species is apparently based upon a small specimen of *Aluta* to which genus we now refer it. Further work is necessary before its relationship to the other species of *Aluta* can be determined.

Occurrence.—Middle Cambrian (Menevian): St. Davids, Wales.

ALUTA(?) RIMULATA, new species

Plate 5, Figure 16

This new species is based upon a complete carapace flattened in the shale, with the result that the surface nodes or ridges are crushed and not very visible. A node on the anterior third and a ridge below it are apparent in other specimens referred here, while still others show the wrinkled appearance often seen in *Aluta*. The two valves also are so similar that they probably would fit close together. The narrow but conspicuous rim along the free edges of the valves will readily distinguish the species.

Occurrence.—Middle Cambrian (Ross Lake shale member of Ptarmigan formation): 3 miles southwest of head of Lake Louise, Alberta.

Holotype.—Cat. No. 81735 U.S.N.M.

Genus EREMOS Westergaard

Eremos (Westergaard Mss.) MOBERG and SEGERBERG, Meddelande Fran Lunds Geologiska Faltklubb, ser. B., No. 2, 1906, p. 75.

Although based upon a Post-cambrian species this genus has such a resemblance to *Aluta* that an illustration of the type is included herewith.

Genotype and only species.—*Eremos bryograptorum* Westergaard.

EREMOS BRYOGRAPTORUM Westergaard

Plate 8, Figure 32

Eremos bryograptorum (Westergaard, Mss.) MOBERG and SEGERBERG, Meddelande Fran Lunds Geologiska Faltklubb, ser. B., No. 2, 1906, p. 75, pl. 3, fig. 24.

Our knowledge of the species is based upon the original illustration reproduced on Plate 8.

Occurrence.—Canadian (*Bryograptus* beds): Fogelsang, Sweden.

Genus HIPPONICHARION Matthew

Hipponicharion MATTHEW, Trans. Royal Soc. Canada, vol. 3, sec. 4, 1886, p. 64.—MILLER, North Amer. Geol. and Pal., 1889, p. 549; Trans. New York Acad. Sci., vol. 14, 1895, p. 132.

Genotype.—Hipponicharion eos Matthew.

Matthew describes three species of this genus, namely, *Hipponicharion eos*, *H. cavatum*, and *H. minus*. While obviously closely related, the forms are yet distinguishable. As to the genus, it is a well-marked stage in the development of these peculiar crustaceans. The family relationship to *Beyrichona* is evident enough in the general shape of the valves, in the mid-dorsal depression, and in the disposition of the surface ridges and nodes. The generic peculiarity of *Hipponicharion* lies in the greater distinctness of the lateral ridges, these extending as sharply defined elevations from the cardinal angles to a point near the middle of the ventral border. The ventral extremities of these submarginal ridges, while more or less closely approximated, still remain sharply separate in Matthew's three species, but in *H. matthewi* Wiman, and even more so in the new *H. confluens*, the gap is closed. Aside from the ridges, the surface of the valves is depressed; in *H. eos* and *H. minus* flat; in *H. cavatum*, rather strongly concave. A node or thin curved ridge occurs a little in front of the middle of the dorsal half of each valve. This node, though recognizable in *Beyrichona*, is much better developed in *Hipponicharion*. It is not possible with the material at hand to determine whether the edges of the two valves are perfectly equal or overlap. If overlap occurs, it is certainly only to a very limited extent. A feature of *H. cavatum*, apparently not observed by Matthew, is a narrow transversly lined marginal frill. No sign of such a frill was observed on the other two species, though the specimens of these are fully as well preserved.

HIPPONICHARION EOS Matthew

Plate 7, Figure 31

Hipponicharion eos MATTHEW, Trans. Royal Soc. Canada, vol. 3, sec. 4, 1886, p. 64, pl. 6, figs. 19, 19*a*, *b*; Trans. New York Acad. Sci., vol. 14, 1895, p. 132, pl. 7, figs. 1*a*, *c*.

Valve semielliptical with anterior and posterior ends elevated into prominent marginal ridges of about equal length, not meeting along the ventral side. These ridges are separated by a depressed flat surface which bears a low ridge near its middle, extending nearly at right angles to the hinge line near which it ends in a low inconspicuous tubercle.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*1); Hanford Brook, St. Martins, New Brunswick.

HIPPONICHARION CAVATUM Matthew

Plate 7, Figure 32

Hipponicharion cavatum MATTHEW, Trans. Royal Soc. Canada, vol. 11, sec. 4, 1894. p. 99, pl. 17, figs. 3*a*, *b;* Trans. New York Acad. Sci., vol. 14, 1895, p. 133, pl. 7, figs. 2*a*, *b*.

As shown by the illustration *H. cavatum* differs from the genotype *H. eos* in that the depressed surface between the marginal ridges is strongly concave instead of flat. Both the marginal ridges and the median one are narrower and higher and the latter is longer and turns at its lower end.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*1, C1*b*3); Hanford Brook, New Brunswick.

HIPPONICHARION MINUS Matthew

Plate 7, Figure 30; Plate 2, Figures 14–16

Hipponicharion minus MATTHEW, Trans. Royal Soc. Canada, vol. 11, sec. 4, 1894, p. 99, pl. 17, figs. 4*a*, *b;* Trans. New York Acad. Sci., vol. 14, 1895, p. 133, pl. 7, figs. 3*a*, *b*.

This species is quite similar to *H. cavatum*, although smaller, and differs in that the lateral ridges are low and almost join at the middle of the ventral edge. The median ridge is shorter and nearer the end of the valve.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*3); Hanford Brook, New Brunswick.

Plesiotypes.—Cat. No. 50552, U.S.N.M.

HIPPONICHARION MATTHEWI Wiman

Plate 2, Figures 17–20

Hipponicharion matthewi WIMAN, Bull. Geol. Inst. Upsala, vol. 6, pt. 1, 1902, p. 49, pl. 1, figs. 40–44.

As indicated in our generic notes, *H. matthewi* is related to the type of the genus, but differs conspicuously in that the gap between the marginal ridges along the ventral border is closed. It, therefore, belongs to the *H. confluens* section of the genus, differing, however, in that the dorsal ridge is at right angles to the margin, as in the typical section, instead of parallel as in *H. confluens*.

Occurrence.—Lower (Middle?) Cambrian; Glauconite sandstone: Eggegrund, Sweden.

HIPPONICHARION PLICATUM, new species

Plate 2, Figure 12

In this new well-marked species the surface between the confluent marginal rim is broken into a series of folds or plications four or five in number and arranged at right angles to the dorsal margin. The ends of the confluent marginal ridge are more strongly marked and appear to be set off as more or less separated elongated nodes. The ridge paralleling the dorsal margin is slightly developed. Lastly, the outline of the valve is more angular than other species of the genus.

Occurrence.—Middle Cambrian (Johannian-C2*b*): McNeil Brook, east of Marion Bridge, Cape Breton, Nova Scotia (3*h*).

Holotype.—Cat. No. 81624, U.S.N.M.

HIPPONICHARION PARVUM, new species

Plate 2, Figure 13

This, the smallest species of the genus so far discovered, belongs to the section in which the marginal ventral ridges are confluent. It is readily distinguished from its close ally *H. plicatum* by its more regular outline and more uniformly developed ridges which occupy the space between the confluent marginal elevation.

Occurrence.—Middle Cambrian (Johannian, division C2*b*): One and one-half miles west of Marion Bridge, Cape Breton, Nova Scotia (3*i*).

Holotype.—Cat. No. 50551, U.S.N.M.

HIPPONICHARION CONFLUENS, new species

Plate 2, Figures 10, 11

This interesting new species is readily distinguished from the more typical members of the genus by the confluent nature of the marginal ridge, which is entire and not broken, as in the type species. A node and a thin slightly curved ridge are present near the dorsal margin forming a further point of distinction.

Occurrence.—Middle Cambrian (Johannian, division C2*b*): One and one-half miles west of Marion Bridge, Cape Breton, Nova Scotia (3*i*).

Holotype.—Cat. No. 81625, U.S.N.M.

Genus POLYPHYMA Groom

Polyphyma Groom, Quart. Journ. Geol. Soc. London, vol. 58, 1902, p. 83.

Carapace bivalved, rather small, 2 to 4 mm. in length, semielliptical or semicircular, the hinge long and straight, the ends subequal. Test thin, chitinous, pliable, surface polished, broken up into numerous

(7 to 12) large and smaller rounded elevations, the largest and most prominent of which occurs usually a little in front of the middle of the ventral edge; with or without a distinct marginal flange.

Genotype.—Polyphyma lapworthi Groom. Cambrian of England.

Two of the four species referred to this genus have hitherto been placed in the ostracod genus *Beyrichia*. The sole reason for the older arrangement is that the valves have nodular elevations suggesting the lobes of a *Beyrichia*. That the several nodes can not be correlated with the lobes or nodes of a true *Beyrichia*, and that all other features, notably the composition of the test, are very different, was not observed except by Holm, who with his usual acumen denied the ostracod nature of the Swedish Cambrian bivalved Crustacea and suggested placing them with the Phyllocarida.[5] For reasons given in the introduction, the present authors regard the balance of the evidence as favoring the Branchiopoda rather than either the Phyllocarida or the Ostracoda.

Compared with other genera, *Polyphyma* seems more nearly allied to *Aluta*, *Beyrichona*, and *Hipponicharion* than to any of the other generic groups. *Lepiditta* and *Isoxys* also are suggested by their shapes, but it is not believed that the relations to either of these genera is at all close. At any rate the shell of *Lepiditta* is thought to have been more calcareous, while the absence of surface nodes affords an obvious criterion in separating the two groups. As to *Isoxys*, its shell was probably not materially different, but considering its nontuberculated valves and the fact that its species grew to such greater size, all thought of genetic relation to *Polyphyma* is dismissed from the investigator's mind.

Reverting to the true allies of the genus, it is distinguished from *Aluta* (as herein defined) and *Beyrichona* by its more nearly semicircular outline and numerous, comparatively variable tubercles. *Hipponicharion*, possibly, is the nearest of these true allies, but is readily distinguished by the segregation of most of the nodes into a continuous or medially divided submarginal ridge, which gives it a very characteristic, regular aspect that is strikingly different from the apparently irregular arrangement of the tubercles in *Polyphyma*.

The adopted orientation of the valves is based on the correlation of the largest of the ventral nodes with the antero-ventral node in *Aluta*. This is located a little to one side of the middle—presumably the anterior—in *Polyphyma*.

[5] Holm, G., Sveriges Kambr.-Silur. Hyolithidae, 1893, p. 110, foot note (Sveriges Geol. Unders., ser. C, No. 112).

POLYPHYMA LAPWORTHI Groom

Plate 8, Figures 26, 27

Polyphyma lapworthi GROOM, Quart. Journ. Geol. Soc. London, vol. 58, p. 84, pl. 3, figs. 1-8.

This species, the genotype of *Polyphyma*, is fully described and illustrated by Groom, so that it is only necessary to point out its chief characteristics as indicated by him and as shown in the reproductions of his original figures on Plate 8. These are a subcentral parallel direct reniform elevation, three tubercles near the dorsal margin and an anterior subtriangular lobe.

Occurrence.—Lowest black shales (Cambrian): Southern Malverns, England.

POLYPHYMA MARGINATA, new species

Plate 8, Figures 28, 29

Description.—Valves semicircular, the height slightly greater than half the length of the hinge line. Surface now rather depressed convex, originally probably ventricose, with 10 to 12 partly confluent rounded nodes separated by narrower depressed spaces. Eight of these are small and in part inconspicuous and arranged closely along the dorsal and posterior margins, while a low ridge parallels the front border. Two much larger nodes, both somewhat crushed in the best specimen, occupy the middle part of the ventral half. The hinder of these two elevations is low and broad based, the forward one a little smaller at the base but rising to a much greater height; whether rounded at the summit or conical can not be determined. A narrow, sharply defined rim forms the extreme edge on the anterior ventral and dorsal sides. Within this the best specimens exhibit two distinct parallel folds, which become obsolete in the postventral part and possibly were produced by compression of the pliable test.

Dimensions of the largest and best specimen, the right valve figured on Plate 8: Length of hinge line about 3.2 mm., greatest height 2.0 mm.

Occurrence.—In black shales classified as upper Cambrian by Doctor Walcott, west side of Manuel's River, Conception Bay, Newfoundland.

Holotype.—Cat. No. 56492, U.S.N.M.

Remarks.—The half dozen or more specimens of this species in the National Museum collection have been subjected to more or less compression; and as they lie variously with respect to its direction, they exhibit a corresponding variety of distortion. Thus, when they lie so that the length is reduced to about half, the nodes seem to arrange themselves in four irregularly undulating vertical ridges. But as each specimen looks different from the others, it is useless

to describe them. Only one, the figured type, seems to retain approximately the normal outline and arrangement of the nodes, and even this was injured along its anterior edge in removing the matrix. Additional material is therefore most desirable.

Excepting the next following species, no other known Paleozoic fossil is at all likely to be confused with good examples of *P. marginata*. From *P. angelini* and *P. armata*, both Swedish species and evidently from older rocks, it is distinguished at once by the marginal rim and folds which seem to be wanting or but ill developed in its foreign congeners.

POLYPHYMA ANGELINI (Barrande)

Plate 8, Figure 30

Beyrichia angelini BARRANDE, Syst. Sil. du Centre Boheme, vol. 1, Suppl., 1872, p. 485.—LINNARSSON, Sveriges Geol. Unders., ser. C, No. 21, 1875, p. 45, pl. 5, fig. 11; Ofvers. k. Vet.-Akad. Forhandl., vol. 32, 1875, p. 43, pl. 5, fig. 11.

All that has been learned concerning this apparently well-marked Swedish species is shown in the photographic reproduction on Plate 8 of the illustration originally published by Linnarsson. According to this the valves are semielliptical, the extremities of the hinge equally sharp, and the height less than half the greatest length, which is about 2.8 mm. A large tubercle is located near the middle of the ventral half, while seven or eight smaller nodes are irregularly distributed over the rest of the surface. The figure does not show a marginal rim, nor is such a feature mentioned in Linnarsson's description. The absence of the rim and of parallel folds within it would suffice in distinguishing the species from its American congener. It may be added further that the outline differs also in that the hinge is relatively longer and the extremities more sharply angular.

Occurrence.—Upper Cambrian, Olenus beds, Andrarum, Sweden.

POLYPHYMA ARMATA (Grönwall)

Plate 8, Figure 31

"Beyrichia" angelini var. *armata* GRÖNWALL Danmarks Geol. Unders., II Raekke, No. 13, 1902, p. 163, pl. 4, fig. 7, p. 220.

This form also is known to the authors only from the figure and description published in the Swedish report cited above. Grönwall distinguished it as a variety of *P. angelini*, but, assuming the published figures of the two forms to be correct, it is thought a specific separation would have been justified. The principal peculiarity of *P. armata* lies in the extraordinary development and confluence of the dorsal nodes, which in both of the other species of the genus are much smaller and more numerous. Then there are two conical tubercles that project beyond the ventral edge and add to the dis-

tinctive features of the species. These two ventral nodes probably represent the submarginal folds of *P. marginata*, while the tubercle just above the anterior one of the two is regarded as corresponding to the principal node in *P. angelini* and *P. marginata*. The dimensions as given by Grönwall are as follows: Length 3.0 mm., height 1.4 mm.

Occurrence.—Middle Cambrian, Davidis zone, near Borregaard, Bornholm, Denmark.

Family INDIANIDAE new family

Small oval bivalved Conchostraca with surface of valves even, smooth, and not exhibiting an ocular tubercle. Valves open along the anterior and posterior ends and widely gaping along the ventral edge. Shell structure corneo-calcareous, polished.

Genus INDIANA Matthew (emended)

Indiana MATTHEW (part), Canadian Rec. Sci., vol. 8, 1902, p. 460; Geol. Surv. Canada, Rep. Cambrian Rocks Cape Breton, 1903, p. 169.
Not *Indiana* JONES, Geol. Mag., Dec. 4, vol. 9, 1902, p. 402.

Carapace bivalved, rather small, 4 to 7 mm. long, the outline a more or less obliquely truncated ellipse, the hinge being straight but of varying length and sharpness of definition. Anterior extremity commonly bowed forward from the antero-dorsal angle, at other times descending vertically from the angle. Postcardinal angle obtuse, occasionally rounded off, more commonly distinct. Posterior margin broader than the anterior, sometimes following a regular elliptic curve, oftener obliquely truncated or even slightly concave in the upper part. Valves rather strongly convex, usually somewhat depressed in the anterior half of the dorsal slope; without nodes. Free edges of valves with or without a delicate external rim, occasionally expanding into a wide, flattened border sometimes developed only on the anterior end; inner side of edge bent inward. Gap between edges of opposite valves widest at the ends, chiefly made up by concavity of the ends of the left valve. Test thin, black to brown or yellow, polished, minutely punctate, somewhat pliable chitinous, including very little calcareous matter in its composition.

Genotype.—*Indiana lippa* Matthew (selected by the writers).

Remarks.—In the original description of *Indiana* by Matthew [6] no genotype was designated. The first species following the generic diagnosis is *I. ovalis*, and this species, under the rules generally prevailing in such cases, has been cited as the genotype. Unfortunately, as has been already mentioned in discussing *Bradoria*, the genus can not be maintained if founded on *I. ovalis*. The imperfect original type of this species, after careful comparison, was positively identified

[6] Canadian Rec. Sci., vol. 8, 1902, p. 460.

with a good species of *Bradoria* in the collections of the National Museum from the same locality. Being distinct, the specific name is retained and the species accordingly has been described on a preceding page under the name *Bradoria ovalis*.

As detailed on a former page, still another of the species referred to *Indiana* by Matthew in 1902 belongs to *Bradoria*, namely, the form described by him in 1898 as *Aparchites? robustus*. The synonymy of this species is very complicated, the study of Matthew's collection of original types having shown that he gave no less than five names, distributed among three genera, to different individuals of one and the same species.

The hitherto accepted genotype of *Indiana* being an unqualified *Bradoria*, the former genus must either fall into synonymy under the latter, or be restored to good standing by the selection of another genotype. The latter course is thought the more advisable, because the genus, as constituted by Matthew, includes a distinguishable group of species, the essential characters of which are brought out in the above revised definition of *Indiana*. Of the other species originally referred to the genus by Matthew, *I. lippa* and *I. pyriformis* are perhaps equally characterisric of the revised genus. The type specimen of the former being rather better preserved than the other, it is selected as the genotype.

Based on *I. lippa* and *I. pyriformis*, both of Matthew, and including the congeneric *Aparchites secunda* Matthew, *Leperditia dermatoides* Walcott, *L. primaera* Matthew, *Primitia acadica* Matthew, *Aparchites anderssoni* Wiman, and the new species of the present work, *I. longula*, *I. suberecta*, *I matthewi*, *I. labiosa*, *I. faba*, *I. curta*, and *I. impressa*, the genus *Indiana* is distinguished from *Bradoria* by the entire absence of ocular and other tubercles. Other differences are found in the greater gap in the ends and ventral parts of the carapace, and in the slight inequality of the dorsal parts of the valves, the margin of the left valve in at least some of the species, extending over the median line of the back so as to overhang the gaps. Again, in most of the species of *Indiana*, the outline of the valves has a retral swing that is quite foreign to the average *Bradoria*. Further, it is to be noted that the angulation of the posterior and anterior parts of the outline frequently seen in species of *Bradoria* is either entirely absent or barely distinguishable in *Indiana*. Finally, the surface of the species to which it is proposed to restrict *Indiana* has, despite its fine punctation, a polish that is never observed in *Bradoria*.

On account of the usual imperfections resulting from crushing, folding, and breakage of the carapaces prior to fossilization, it is likely that some difficulty may be experienced in distinguishing certain forms from species belonging to the new genus *Mononotella*, founded on the species originally described by Matthew as *Primitia? fusifor-*

mis, but later referred by him to *Indiana*. In this new genus the carapace, instead of consisting of two valves, is composed of a single plate folded in such a manner that only perfect specimens are readily distinguished from *Indiana*.

For a discussion of the relations of *Indiana* to *Walcottella* and *Dielymella*, see the remarks under the descriptions of those genera.

INDIANA LIPPA Matthew

Plate 9, Figures 1–4

Indiana lippa MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 463, pl. 2, figs. 10*a*–10*d*; Geol. Surv. Canada, Rep. Cambrian Rocks Cape Breton, 1903, p. 171, pl. 13, figs. 10*a*–10*d*.

Description.—Carapace subovate, widest posteriorly, hinge slightly exceeding half of the greatest length, cardinal angles obtuse but definite, anterior margin rounded, ventral margin broadly convex, posterior outline strongly convex in lower two-thirds, straight in upper third to the dorsal angle. Valves moderately convex, slightly depressed in the antero-dorsal region; with a broad, obscurely defined ventral border turned inward at the extreme edge. Test very thin, black and shiny in the dark matrix, minutely punctate.

Dimensions of the best and most typical of the National Museum's specimens: Greatest length 5.2 mm., length of hinge line 2.8 mm., greatest height 3.1 mm., thickness about 2.7 mm.

Remarks.—The original types of this species consist of a complete carapace and the cavity from which it was removed. Four specimens, one precisely like Matthew's type, the other less confidently referred, were detected in the Walcott collections. Judging from all these specimens, the species occupies an intermediate position between *I. secunda*, *I. pyriformis*, and *I. dermatoides*, on the one hand, and *I. acadica* and *I. primaeva* on the other. In the first three species the posterior half is proportionally wider, and hence the ventral edge more oblique; in the latter two, the two ends of the valves are less unequal and the ventral and dorsal sides of the outline therefore more nearly parallel. The anterior end being rounded as in *I. secunda* and *I. pyriformis*, the present species is thought to be more closely allied to these than to *I. dermatoides* and *I. primaeva*, in which the antero-dorsal angle is more prominent and the upper part of the anterior outline nearly vertical.

The contour of the valves is rather strongly convex in all of these species and the surface markings, consisting of minute, widely separated punctae, are not materially different. An obscure umbonal angulation extending obliquely backward from the antero-dorsal angle is perhaps a more prominent feature in *I. lippa* than in the others.

Occurrence.—Lower Cambrian (Upper Etcheminian-div. E3*e*, E3*f*) Dugald Brook, Cape Breton. Occurs also in the Hanfordian C*l*b3, Hanford Brook, New Brunswick.

Plesiotypes.—Cat. Nos. 56474–56476, U.S.N.M.

INDIANA SECUNDA (Matthew)

Plate 9, Figures 5–8

Aparchites secunda MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 136, pl. 7, figs. 11*a*, 11*b*.

Description.—Carapace obliquely subovate, much narrower in front than behind; hinge straight, somewhat exceeding half the length of carapace, the anterior angle fairly distinct, the anterior margin obliquely subtruncate, extending a little beyond the angle, rounding sharply below into the gently convex and anteriorly ascending ventral margin; posterior end long and wide, strongly rounded in outline except the upper third, which rises with a straight slope to the obtuse but clearly defined postcardinal angle. Valves strongly convex, with or without a very narrow, barely distinguishable rim; gap rather wide at both ends and along ventral side. Surface of shell polished and punctated as usual.

Dimensions of typical specimen: Greatest length (obliquely across carapace) 4.1 mm., length of hinge line 2.8 mm., greatest height 2.8 mm., thickness about 2.1 mm.

Remarks.—Matthew's collection of types contains three specimens. One of these, an entire carapace, was figured by Matthew and is the original of Figure 5 on Plate 9. It is, therefore, regarded as the holotype. The other two specimens are somewhat imperfectly preserved valves, but, so far as can be seen, belong to the same species as the type.

Matthew's figure of the left side of the type represents the ventral margin as more convex, and consequently the height of the posterior half as somewhat greater than it is in the original. The dorsal angles also are too much rounded in his illustration. These slight inaccuracies are corrected in Figure 6 on the same plate.

The relatively narrow anterior extremity and the pronounced retral swing of the outline serve to distinguish the species from *I. lippa*. In *I. longula*, however, both of these features are developed to an even greater extent. *I. dermatoides* is a close ally, and the discrimination of the two forms may occasionally prove difficult. However, with good specimens the nearly rectangular antero-dorsal part of the outline and the more convex ventral side of *I. dermatoides* make the task of separation reasonably easy.

Another very close alliance seems to be with *I. anderssoni* (Wiman) from the Glauconite sandstone of Sweden. Wiman's type evidently is somewhat crushed; but if the outline as represented in the illustra-

tions of the Swedish species is correct, it may be distinguished as a variety by its more prominent and sharply rounded anterior extremity.

Occurrence.—Lower Cambrian (Hanfordian Protolenus zone, division C1*b*2), Hanford Brook, St. Martins, New Brunswick. Seven specimens in the United States National Museum, collected by Doctor Walcott in Greenwich Township, Washington County, N. Y., occurred in an arenaceous limestone referred by him to the Lower Cambrian.

Cat. No. 56467, U.S.N.M.

INDIANA ANDERSSONI (Wiman)

Plate 9, Figures 22–25

Aparchites? anderssoni WIMAN, Bull. Geol. Instit. Upsala, vol. 6, pt. 1, 1902, p. 45, pl. 1, figs. 25–28.

All the available information concerning this species is contained in the description and figures published by Wiman. Judging more especially from the latter, the species is thought to be founded on a crushed example of an *Indiana* closely related to *I. dermatoides* and *I. secunda*. Compared with the latter the only difference noted that is not manifestly the result of injury lies in the more prominent and narrowly rounded anterior extremity. Even this difference may have been produced by the injury and loss of the anterior cardinal angle. Only a restudy of Wiman's type specimens with these possibilities in mind can determine the validity of the species and its true relations to the American species.

Occurrence.—Lower (? Middle) Cambrian, Glauconite sandstone; Eggegrund, Sweden.

INDIANA PYRIFORMIS (Matthew)

Plate 9, Figures 11, 12

Primitia pyriformis MATTHEW, Trans. Royal Soc. Canada, ser. 2, vol. 4, sect. 4, 1898, p. 132, pl. 1, figs. 3 *a–c*.

Indiana pyriformis MATTHEW, Canadian Rec. Sci., vol, 8, 1902, p. 461.

This form is represented in the Matthew's collection of types by two specimens from Long Island, New Brunswick, both left valves of exactly the same shape. The surface in both is somewhat injured by exfoliation and corrosion, but retains sufficient evidence of its character to prove that it is finely punctated as in *I. secunda*. Carefully compared with the types of that species, few differences, and hardly any of consequence, were noted save in the matter of size, the types of *I. pyriformis* being nearly twice as long as those of *I. secunda*. However, as two specimens from Hanford Brook and two others from Washington County, N. Y., in the United States National Museum, hold the same dimensions, and as none of intermediate size is known, it is thought advisable to maintain the two forms as dis-

tinct—whether as varieties or good species to be determined hereafter. In distinguishing them, after the great difference in size, it is to be noted that the valves of *I. pyriformis* are relatively wider in front, the hinge is longer, and the postdorsal angle not so broad, while the posterior margin turns downward more rapidly. In consequence of these small peculiarities, the retral swing of the outline is less striking than it appears in *I. secunda.*

In the figure of a left valve published by Matthew the angular form of the postcardinal region is not so well brought out as in the right valve represented by our new figure. Critically compared, a slight difference in thickness of valves is noted between the New Brunswick and New York specimens. The latter are less convex than the former but the difference is due, in part at least, to compression.

Dimensions: Greatest length (diagonally across the carapace) 6.8 mm., length of hinge 4.1 mm., greatest height 4.7 mm., thickness of right valve 1.7 mm.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*31), Long Island, Kings County, New Brunswick; Hanford Brook, St. John County, New Brunswick. In Washington County, N. Y., the species occurs in association with *I. dermatoides* and *I. secunda*, in limestone correlated as Lower Cambrian by Doctor Walcott.

Plesiotype.—Cat. No. 56470, U.S.N.M.

INDIANA LONGULA, new species

Plate 9, Figures 19–21

Description.—Carapace larger than usual for the genus, obliquely subelliptical, produced posteriorly, the postventral extremity narrowly rounded; anterior end small, truncated vertically with respect to the hinge line; hinge short, less than half the greatest diameter of carapace; post-dorsal angle undefined, the anterior conspicuous but rounded off. Other features apparently the same as in *I. secunda.*

Dimensions: Greatest length (measuring from the antero-dorsal angle to the post ventral margin) 7.5 mm., length of hinge about 4 mm., width from middle of ventral side to the post dorsal edge 4.5 mm., thickness 3.5 mm. or more.

Remarks.—But a single example of this species has been seen. It retains both valves in nearly perfect condition. The edges of the valves have all the appearance of overlapping along the ventral side as in *Leperditia*, but this condition is most probably abnormal. That it resulted from the valves being forced together is indicated by the ragged edge of the overlapping (left) valve, as shown in our figure.

Except that the specimen is much larger, it bears a striking general resemblance to *I. secunda.* On closer comparison, however, it is

observed that the anterior edge of *I. longula* is less rounded and more nearly rectangular with respect to the hinge line, the postero-dorsal part of the outline more rounded, the posterior terminus of the hinge ill-marked, the postventral extremity more prolonged, and the angle of the longest axis of the carapace to the hinge line wider. In the last respect *I. longula* agrees with *I. pyriformis*, but the postdorsal angle is so much better developed in that species that these two forms, despite the fact that they are nearly equal in size, are not likely to be confused. A closer ally than either of the former seems to be indicated in *I. dermatoides*, a New York species of nearly the same age. Still the latter is easily distinguished by its more sharply defined cardinal angles, less oblique form, and less narrowly rounded posterior extremity. It is also a smaller form. Another close relative is the new *I. suberecta*, but the shorter hinge and more erect habit of the latter are such striking differences that a glance suffices in distinguishing them. The other remaining species referred to *Indiana* are too obviously different to require comparison.

Occurrence.—Lower Cambrian (Hanfordian division C1*b*3); Hanford Brook, St. John County, New Brunswick.

Holotype.—Cat. No. 50558, U.S.N.M.

INDIANA SUBERECTA, new species

Plate 9, Figure 28

Description.—Carapace slightly exceeding the average for the genus in size, subelliptical in outline, truncated dorsally so that when the hinge is placed horizontally the habit is more nearly erect than in any other species; anterior side and hinge line forming a right angle, postdorsal angle obtuse but fairly distinct; ventral margin very gently convex, the turn into the anterior edge rather abrupt but not angular; posterior outline strongly convex in the lower third, gently rounded in the middle third, and straight, with a decided anterior inclination, in the upper third; between the middle and upper thirds an obtuse angulation; hinge line short, its length barely exceeding one-third of the greatest diameter of carapace. Valves moderately convex, thickest in the posterior half, with blunt, rimlike edges. Test black, with very minute, crowded punctae, distinctly visible only under a high power of magnification.

Dimensions of type specimen, a right valve: Greatest diameter (from antero-dorsal angle to postventral edge) 5.2 mm., length of hinge line (slightly imperfect) about 2 mm., greatest width of posterior half (measuring diagonally across valve) 3.2 mm., greatest thickness about 1.1 mm.

Remarks.—This species is distinguished by its comparatively erect habit and short hinge. In both features it is approached by *I. lon-*

gula, but that species is readily separated by its more narrowly rounded posterior extremity and more uniformly rounded postdorsal edges. It is also allied to the associated *I. dermatoides*, but the punctation of its test is more minute and more crowded, and when properly oriented the shape of the valves is quite different.

Occurrence.—Lower Cambrian, limestone outcropping on Reid's farm, 1½ miles north of Bald Mountain, Greenwich Township, Washington County, N. Y.

Holotype.—Cat. No. 56469, U.S.N.M.

INDIANA DERMATOIDES (Walcott)

Plate 9, Figures 16, 17

Leperditia dermatoides WALCOTT, Amer. Journ. Sci., ser. 3, vol. 34, 1887, p. 192, pl. 1, figs. 13, 13*a*; 10th Ann. Rep. U. S. Geol. Surv., 1890, p. 626, pl. 80, figs. 1, 1*a*.—MATTHEW, Amer. Geol., vol. 8, 1891, p. 290.—COBBOLD, Quart. Journ. Geol. Soc., vol. 76, 1921, p. 368.

Indiana dermatoides CHAPMAN, Proc. Royal Soc. Victoria, new ser., vol. 31, 1918, p. 109.

Description.—Carapace of medium size, subelliptical in outline, the ellipse obliquely truncated along the hinge line; dorsal angles distinct, the anterior about 100°, the posterior about 135°; hinge less than half the total length of carapace, constructed seemingly so that in its posterior half the edges of the opposite valves overlap; anterior end narrow, the outer margin curved gently and so that its most prominent point projects but slightly beyond the dorsal angle; ventral part of outline moderately convex, trending obliquely backward toward the posterior extremity, around which the outline continues with a semicircular curve; upper third of posterior margin nearly straight. Valves moderately convex, highest in the posterior half, the slope near the antero-dorsal half rather more abrupt than elsewhere; apparently without a flattened rim. Test thin, black, distinctly punctate; punctae rather closely arranged.

Dimensions of left valve (original type of species): Greatest length 5.9 mm., length of hinge line 3.1 mm., distance from middle of ventral edge to postdorsal angle 3.3 mm., thickness about 1.3 mm.

Remarks.—The original collections used by Doctor Walcott in describing this well-marked species proved to contain at least two distinct forms, the second being now referred to *I. secunda* (Matthew). Other specimens of the original lot are either too imperfect or insufficiently prepared to admit of definite classification. A third species, *I. suberecta* of this work, does occur in the same bed, and it is therefore not improbable that it also is represented among the undetermined specimens.

Critically compared with the other species of *Indiana*, *I. dermatoides* appears more or less closely allied to *I. secunda*, *I. pyriformis*,

I. longula, and *I. suberecta*. From the first and second of these allied species it is readily distinguished by its shorter hinge line and correspondingly more produced posterior end. The differences are quickly noted in comparing the truncation of the species. For the same reasons the posterior half of the valves appears to be narrower in *I. dermatoides*. The other two species, *I. longula* and *I. suberecta*, differ in the opposite direction. In both the hinge line is even shorter, and when this line is placed horizontally their carapaces appear more erect. The latter difference is best shown by the strong downward trend of the anterior and ventral sides from the horizontal hinge line. A closer relative, perhaps, than any of the named species is indicated in the following *I. matthewi*. For comparisons see remarks under that species.

Occurrence.—In thin limestone intercalated in or overlying the Cambrian roofing slate referred to the Lower Cambrian by Doctor Walcott at several localities in Greenwich Township, Washington County, N. Y. A single specimen, injured in front, and therefore somewhat doubtfully referred to the species, is from the "Middle Cambrian" (C1c) at Hastings Cove, Kennebecasis River, 6 miles east of St. John, New Brunswick. Identified by Cobbold in the Lower Cambrian limestone with *Strenuella* at Comley, England.

Holotype.—Cat. No. 17474, U.S.N.M.

INDIANA MATTHEWI, new species

Plate 9, Figure 15

Description.—Carapace small, obliquely subovate, narrowing anteriorly, hinge line three-fifths of greatest length, postdorsal angle obtuse, sometimes even rounded off, anterior angle sharply defined, almost rectangular; anterior margin scarcely bowed in upper part, the curve from the dorsal angle to the postventral side decreasing very gradually and on the whole gently; posterior margin more strongly convex, with greatest prominence in lower half; upper half oblique, in most instances appreciably straightened. Valves without rim, but the anterior edge, especially of the left valve, is sometimes raised slightly as though to widen the gap between the valves; surface moderately convex, the highest point a little behind the center; a more or less obvious but wide and undefined depression in the dorsal slope. Test light brown or black, smooth and sometimes polished, apparently not punctate.

Dimensions of largest specimen: Greatest length 4.0 mm., length of hinge line 2.3 mm., greatest height 2.8 mm., thickness (of single valve) about 1.15 mm.

Remarks.—In most respects this species occupies an intermediate position between *I. secunda* and *I. dermatoides*. It differs from both in the more rectangular form of the antero-cardinal part of the

outline, in the greater convexity of the ventral margin, and in its non-punctate test. From the former it differs further in the proportionately greater height and hence in its more broadly rounded posterior end. Its average size, finally, is somewhat greater. It is considerably smaller than the average for *I. dermatoides*, has a relatively longer hinge line, and is less produced posteriorly. In its departure from these two species, *I. matthewi* approaches *I. primaeva* (Matthew), which see for comparisons.

Occurrence.—Middle Cambrian (Acadian-Paradoxides zone C1*c*), Hastings Cove, Kennebecasis River, 6 miles east of St. John, New Brunswick (2*s*) (holotype); one specimen from the Hanfordian, upper part of C1*b*3 of Matthew's *Protolenus* zone, at Hanford Brook, St. John County, New Brunswick.

Holotype.—Cat. No. 50555, U.S.N.M.

INDIANA PRIMAEVA (Matthew)

Plate 9, Figures 9, 10

Leperditia (?) primaeva MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 138, pl. 8, figs. 6*a*, *b*.

A good right valve and two left valves in the collections of the National Museum agree in all respects save size too closely with Matthew's description and figure of *Leperditia? primaeva* to justify specific separation. His type is from Hanford Brook, where it occurred in the lower part of assize 3 of Matthew's section. Unfortunately it was not included in the collection of types loaned by the Toronto University. The specimens in the United States National Museum were collected by Walcott at Hastings Cove from apparently the same general horizon as assize 3 of the Hanford Brook section. They belong to an unquestionable species of *Indiana* as here revised, but without seeing Matthew's figured type of *L.? primaeva*, hesitancy is felt in stating positively that it belongs to the same genus and species, although the inclination to this belief is strong. Taking the characters chiefly from the specimens in hand, *I. primaeva* may be briefly described as follows:

Description.—Carapace subovate, relatively shorter and less oblique than usual; hinge long, cardinal angles well defined, the anterior and dorsal edges forming an angle of about 100°, the posterior angle much wider; ends unequal, though less so than in preceding species; lower half of the anterior outline turning backward with a full curve in both valves, but the upper half varies in the two valves, being nearly rectangular in the right and rounded in the left; posterior margin broadly rounded below, nearly straight in the upper third in the right and straight or even a trifle concave in the left; ventral outline rather strongly convex, ascending somewhat faster toward the front. Valves strongly convex, without nodes, but showing an ill-defined yet in certain lights not inconspicuous

depression in the middle of the anterior two-thirds of the dorsal slope. An obscure flattening, caused by a slight elevation of the anterior margin and resulting in a corresponding increase in the gap between the valves, is noticeable on the left valve but not on the right. Test very thin, light brownish to black in color, very minutely and faintly punctate, polished.

Dimensions of right valve: Greatest (diagonal) length 3.4 mm., greatest horizontal length 3.3 mm., length of hinge 2.0 mm., greatest height 2.7 mm., thickness about 1.2 mm. Judging from the figure of Matthew's type of *L.? primaeva* its length is approximately 5.1 mm.

Remarks.—In forming the conclusion that the Hastings Cove specimens are referable to *I. primaeva*, the right valve shown in Figure 10 on Plate 9 is chiefly relied on. In comparing this valve with Matthew's figure of *Leperditia? primaeva*, reproduced on the same plate, it will be observed that the former is somewhat wider posteriorly and that the dorsal angles are sharper. These differences, however, may very well be due to incomplete preparation of Matthew's type, a possible criticism for which there has been frequent occasion in the course of the present studies, respecting the original figures of that author's species of bivalved Crustacea. A narrow strip of matrix covering the posterior parts of either the dorsal or ventral edges of the Hastings Cove specimen would cause its exposed parts to agree almost exactly with Figure 9. Even if the type proves to have been perfectly prepared, its apparent peculiarities, regarding its greater size, are scarcely of sufficient importance to warrant specific distinction.

As figured by Matthew, *I. primaeva* should be closely related to the Grand Canyon species *I. faba*, which is distinguished solely on the assumption that Matthew's type is not accurately represented by the original illustration. Should this assumption prove ill-founded, then *I. faba* would become a synonym or variety of *I. primaeva* (Matthew) (not Ulrich and Bassler) and *I. primaeva* Ulrich and Bassler (not Matthew), would be subject to renaming.

Some misgivings may arise in the minds of students concerning the propriety of referring the obviously different left valves to this species. It is done chiefly for the reason that *I. matthewi* has similarly differing valves. Indeed, these two species are closely allied, differing chiefly in the fact that *I. primaeva* is relatively shorter.

Occurrence.—Lower Cambrian (Hanfordian C1*b*3) at Hanford Brook, St. Martins, New Brunswick. The United States National Museum specimens were collected from apparently equivalent beds at Hastings Cove, Kennebecasis River, about 6 miles east of St. John, New Brunswick.

Plesiotype.—Cat. No. 56465, U.S.N.M.

INDIANA LABIOSA, new species

Plate 9, Figures 26, 27

Description.—Carapace exceeding the average in size, rather elongate subelliptical in outline, but slightly oblique, dorsal edge straight, fully two-thirds as long as the greatest length of carapace; dorsal angles well defined, the anterior sharper than the posterior; ends subequal, rounded, the posterior extending a trifle farther beyond the dorsal angle than does the anterior; ventral part of outline moderately convex, somewhat produced and obtusely angular near the middle. Surface of valves moderately convex, originally probably well rounded, in the present compressed condition appearing somewhat flattened in the median portion and relatively steep adjacent to the margin; ventral margin with a distinctly flattened rim becoming gradually obsolete as it passes round the ends. Test mostly destroyed by solution, the delicate remnants along the dorsal and ventral edges black; surface markings unknown.

Dimensions: Length 5.8 mm., greatest height, including ventral border, 4.0 mm., excluding border 3.6 mm., thickness of right valve 1.0 mm. or more.

Remarks.—The broad flattened ventral rim gives this species an aspect not shared by any other of the genus known. In general form it is greatly like Matthew's figure of his *Leperditia? primaeva* but somewhat less in accord with the specimens tentatively referred to that species under the name *Indiana primaeva*. *I. labiosa* differs from both in being larger and relatively more elongate besides having a flat border unlike anything seen in *I. primaeva*. The two species from the Bright Angel shale next described are probably its closest known allies. The reader is referred to the remarks following the descriptions of those species for detailed comparisons.

Occurrence.—Middle Cambrian, Stephen formation, in bed 2*d* of Walcott's section at Mount Bosworth, British Columbia.[7]

Cotypes.—Cat. No. 56464, U.S.N.M.

INDIANA FABA, new species

Plate 5, Figures 10–14

Description.—Carapace of medium size, subovate, moderately inequilateral; hinge straight, about two-thirds as long as the greatest diameter, its extremities sharply defined in the dorsal angles; ends subequal, the posterior the more produced and more strongly rounded in its lower half than the anterior; ventral margin rather strongly convex. Surface of valves without nodes, moderately convex, the point of greatest elevation in front of the middle; without a flattened

[7] See Smithsonian Miscellaneous Collections, No. 1812, p. 211.

border. Test thin, white to brown, smooth, occasionally with obscure, very minute, crowded punctae.

Dimensions: Length 5.1 mm., greatest height 3.9 mm., thickness of entire carapace 2.2 mm.

Remarks.—As already mentioned, this form is greatly like the original figure of *I. primaeva* (Matthew). For reasons given it is thought that this figure may not be entirely accurate, but in the absence of the type specimen this point could not be determined positively. In the meantime, having referred to *I. primaeva* certain specimens that are clearly distinct from this Arizona species, it became necessary to apply a different name, namely *I. faba*, to the latter. Even in the event that *I. primaeva* proves to have been correctly figured by Matthew, the new name *faba* may still be retained in a subordinate sense, because the specimens to which the latter name is here applied are relatively a little higher than Matthew's specimen.

Compared with other species of the genus described on preceding pages, only *I. labiosa* is at all similar. Even this is easily distinguished, being longer and having a well defined ventral border. The following *I. curta* is still shorter, but *I. impressa* is proportionately longer and has an undefined, broad mesial depression.

Occurrence.—Middle Cambrian, Bright Angel shale, Grand Canyon of the Colorado, Ariz. Most of the specimens are from the Chuar Valley. Three specimens from just above the massive sandstone of the formation near mouth of Bass Canyon. The latter were associated with most of the species of *Walcottella* described in this work.

Cotypes.—Cat. Nos. 56458, 56459, U.S.N.M.

INDIANA FABA INTERMEDIA, new variety

Plate 5, Figure 15

A single specimen in a fair state of preservation differs too much from average examples of *I. faba* to be referred to it without qualification. With more specimens it might be distinguished as a good species; but having noted but a single example, and this slightly distorted by pressure, it is thought best to separate it only as a variety. Compared with the typical form of the species, it is found to be proportionally longer, its ends more equally curved so that it is difficult to distinguish the anterior from the posterior, the central part of the surface less convex, and the punctae of the test more distantly arranged. The last fact possibly indicates more important genetic differences than can be made out with the material now available for study.

Occurrence.—Bright Angel shale, just above the lower massive sandstone, Chuar Valley, Grand Canyon of the Colorado, Ariz.

Holotype.—Cat. No. 56462, U.S.N.M.

INDIANA CURTA, new species

Plate 5, Figure 9

This species is founded on a single left valve so much like *I. faba* that a detailed description may be dispensed with. However, in looking over the material of *I. faba*, which consists of more than 30 specimens, this valve was at once separated on account of its comparatively short form. The difference in this respect is clearly shown by the illustrations of the two forms on Plate 5. *I. curta* is probably merely a well marked variety of *I. faba*, but in the absence of satisfactory intermediate stages, it has been thought preferable to view it provisionally as a distinct species.

Dimensions: Length 4.25 mm., height 3.51 mm.

Occurrence.—Bright Angel shale, just above massive lower sandstone, near mouth of Bass Canyon, Grand Canyon of the Colorado, Ariz.

Holotype.—Cat. No. 56466, U.S.N.M.

INDIANA IMPRESSA, new species

Plate 10, Figure 2

Description.—Carapace of medium size, obliquely subovate, the ends nearly equal in width; dorsal edge straight, nearly three-fourths the length of the valves; cardinal angles readily determinable but not sharply defined, apparently more obtuse in the left than in the right valve; anterior margin with greatest prominence and curvature in the upper half, trending backward in the lower half; posterior margin strongly rounded in the middle and lower thirds, occasionally, as in the figured specimen, slightly truncate in the upper third; ventral margin gently convex, its course in general approximately paralleling the hinge. Surface of valves on the whole gently convex, broadly depressed in the median third, sloping rapidly at the ends which are blunt; an ill-defined furrow within the ventral edge forms a rather wide, flattened border that dies out before reaching the ends. Test white or brown, smooth, apparently not punctate.

Dimensions: Length 4.1 mm., height 2.7 mm., greatest thickness about 1.0 mm.

Remarks.—This species is readily distinguished from all others referred to the genus by the broad median depression of the surface. Of known forms it is perhaps nearest *I. faba* var. *intermedia*, but as this also is without the median depression and differs further in minor details of outline, and in the more important fact that it has no furrow in the ventral slope, there is little excuse for confusing them.

In its most characteristic feature *I. impressa* suggests *Dielymella dorsalis*, which also occurs in the Bright Angel shale. However,

the mesial depression is less conspicuous in that species, and this, together with obvious differences in outline and size, preclude the possibility of specific identity. As to their generic relations there is less certainty.

Occurrence.—Bright Angel shale just above lower massive sandstone, near mouth of Bass Canyon, Grand Canyon of the Colorado, Ariz.

Holotype.—Cat. No. 56463, U.S.N.M.

DOUBTFUL SPECIES

INDIANA ? ACADICA (Matthew)

Plate 9, Figure 13

Primitia acadica MATTHEW, Trans. Royal Soc. Canada, vol. 3, sec. 4, 1886, p. 66, pl. 6, figs. 22, 22*a*, *b;* Trans. New York Acad. Sci., vol. 15, 1896, p. 196, pl. 15, figs. 5*a–c*.

This species is known only from the imperfect specimen first described and figured by Matthew, as noted above, in 1886. An examination of this specimen, which was loaned by the University of Toronto with the other types of bivalved Crustacea described by Matthew, shows that it is in good condition except for a strip along the hinge which is broken away. The outline seems to have been somewhat elongate elliptical, the surface rather strongly convex, the edge rounded inward, and the test thin, noncalcareous, polished, and distinctly punctated. These features remove the species from *Primitia* and point strongly to *Indiana*. Further, assuming that the missing part is only that immediately adjacent to the hinge line, it is inferred that the specimen is a left valve of a species of this genus closely allied to *I. secunda*, *I. dermatoides*, and *I. suberecta*. A perfect specimen might possibly prove identical with one of these species, but so far as it goes, the imperfect type of *I.? acadica* can not be exactly correlated with the supposed corresponding parts of any described species. Still, it should be confessed that this assertion is based chiefly on the conviction that the part missing from the specimen is not, as Matthew thought, merely the antero-cardinal part, but that it includes the whole of a short hinge, and that the line of fracture is approximately parallel to the removed dorsal edge. If this supposition is correct, then the species must be one of the strongly oblique forms with a broadly rounded posterior margin, like *I. dermatoides* and *I. suberecta*. In the matter of size, *I.? acadica* agrees much better with *I. secunda* than with the other species referred to in these remarks.

As the injury to the type specimen has removed the back and cardinal angles, which parts afford the most diagnostic specific characters of *Indiana* and allied genera, it may never be possible to identify the species beyond question. However, a feature not observed

in other forms may serve as a satisfactory clue. This is a slightly depressed, very minutely granular circular spot, situated near the middle of the valve. This probably represents the external aspect of a muscle spot corresponding to a similarly located smooth spot observed in internal casts of *I. primaeva* (?Matthew) Ulrich and Bassler and *Bradoria steadi* (Matthew).

Occurrence.—Middle Cambrian (Acadian, division C1c1), Porter's Brook, St. Martins, New Brunswick.

INDIANA? MINIMA Wiman

Plate 9, Figure 14

Indiana? minima WIMAN, Bull. Geol. Inst. Upsala, vol. 6, pt. 1, 1902, p. 48, pl. 1, figs. 38, 39.

Wiman's figures of this doubtful species are reproduced on Plate 9. Judging solely from these figures and the original description, it seems highly improbable that the species really belongs to *Indiana*, or indeed to any established genus of Cambrian bivalved Crustacea. Its small size and elliptical form suggests Ostracoda like *Cytherella* and *Bythocypris*, but the fact that its shell is "chitinous, black and polished," probably precludes all likelihood of genetic relationship to such later Crustacea. In the character of its test it appears to agree with the majority of the Cambrian bivalves treated in this work. Though *Indiana* affords perhaps as good a temporary lodgment for the species as any known genus, it must finally be removed on account of the strong convexity of the dorsal side of the outline. In all true species of *Indiana* the back is straight. In size, too, they greatly excel *I.? minima*, the length of the latter being only about 1.1 mm.

Occurrence.—Drifted glauconite sandstone, Åland, Sweden. Probably Middle Cambrian.

INDIANA? SOLVENSIS (Jones)

Plate 9, Figure 29

Leperditia solvensis JONES, Ann. Mag. Nat. Hist., ser. 2, vol. 17, 1856, p. 95, pl. 7, fig. 15.—SALTER, Proc. Geol. Soc. London, vol. 20, 1864, p. 238.

Primitia solvensis JONES and HOLL, Ann. Mag. Nat. Hist., ser. 4, vol. 2, 1868, p. 55 (*footnote*).

Assuming that the original type of this species is really of Cambrian age, and being convinced that true Leperditiidae were not developed before the close of the Ozarkian period, it is deemed advisable to refer it to the Cambrian genus most suggested by the meager description and figure published by Jones. According to the latter, a copy of which is given on Plate 9, it seems to agree best with species of *Indiana*, the outline suggesting *I. lippa* rather more than any of the others. Jones describes the ends and ventral margin as having "a well defined, flattened, marginal rim," a feature that, while unusual

in *Indiana*, is yet occasionally observed in American species of the genus (for instance, *I. labiosa*).

Occurrence.—The type specimen is said to be an "impression of the outside of a small (right) valve" one-eighth of an inch in length and but slightly convex, found in the basal part of the Llandeilo Flags of South Wales, at Upper Solva, Solva Harbour, St. Davids. Hicks subsequently gives the horizon as the Menevian Paradoxides bed.

INDIANA? CAMBRENSIS (Hicks)

Plate 9, Figure 18

Leperditia cambrensis HICKS, Quart. Journ. Geol. Soc. London, vol. 27, 1871, p. 401, pl. 15, figs. 15–17.—ETHERIDGE, Mem. Geol. Surv. Gt. Britain, vol., ed. 2, 1881, p. 487.

This species is removed from *Leperditia* to *Indiana* for reasons practically the same as those inducing a similar course with respect to *L. solvensis* Jones. As in that case, the species is known only from poor figures and quite inadequate remarks. The specimens are said to much distorted by pressure, and the figures (reproduced on Plate 9) vary so greatly that, with the evidence now available, it is impossible to decide as to the specific relations of the species. Jones, who saw the specimens, regarded them "as undeterminable." [8] If figure 15 is approximately like the normal form it would be a close ally of *I. lippa*. The other two specimens are probably of a different type. Both recall another Cambrian species from the same locality subsequently described by Jones as *Leperditia hicksii*. The latter is here referred tentatively to *Bradoria*.

Occurrence.—Red shales in lower part of the "Longmynd group," Lower or Middle Cambrian, St. Davids, South Wales.

INDIANA LENTIFORMIS (Cobbold)

Plate 9, Figure 30

Leperditia? lentiformis COBBOLD, Quart. Journ. Geol. Soc., vol. 96, 1921, p. 367, pl. 24, figs. 46 *a–c*.

Diagnosis.—General outline bean shaped; anterior end shortly truncate; dorsal border gently convex for about two-thirds of the total length, then bending more rapidly and passing to the posterior rounded end in a line that is almost straight; ventral border one long fairly regular curve from the truncate anterior to the posterior end; surfaces of both valves regularly convex, except near the anterior end, where there is a short ill-defined depression passing obliquely towards the ventral border; test thin, corneous, having the surface marked by a network of impressed lines, the interspaces being convex, and more or less elongate and parallel with the border.

[8] Quart. Journ. Geol. Soc. London, vol. 28, 1872, p. 184.

Dimensions.—Length = 11.5 mm.; depth = 7 mm.; thickness of the two valves together = 4 mm. (Cobbold, 1921.)

Although apparently a valid species of *Indiana*, *Leperditia lentiformis* is unusual in the large size of its carapace.

Occurrence.—Lower Cambrian, Olenellus limestone: Comley, Shropshire, England.

DIELYMELLA, new genus

Description.—Carapace bivalved, 5 to 10 mm. long; outlines pod shaped in lateral view, acutely elliptical in edge views, thickest in the anterior half; valves not closing tightly, leaving a narrow gap that extends from the anterior extremity of the hinge around the ventral edge and through the postdorsal region; gap usually narrowest in the ventral part and widest about the middle of the posterior side; anterior extremity truncated, forming an angle of 90° or less with the hinge line; the antero-dorsal extremity generally beaklike, suggesting the rostrum of a pelecypod but not projecting above the hinge line; posterior outline strongly rounded, ventral edge more gently convex; hinge line long, straight. Surface of valves moderately convex, slight posteriorly but gradually rising toward the umbo. Test thin, in color and probably chemical composition like that of a linguloid brachiopod; surface smooth or finely punctate. Interior of valve with a minute elevation in the rostral cavity which is indicated in the cast by a corresponding depression. Usually an obscure fold extends downward from this elevation and parallels the anterior margin.

Genotype.—*Dielymella recticardinalis*, new species.

Like *Walcottella*, most of the known species of this new genus of bivalved crustacea occur in the Bright Angel shale of the Grand Canyon. While the species of the two genera are not all associated, it is yet a fact that common occurrences prove them all to belong to essentially the same bed. Only *D. recticardinalis* is confined to a single locality at which no species of *Walcottella* has been recognized, but with it occur *D. appressa* and *D. nasuta*, both of which seem to be abundant at the Bass Canyon locality from which most of the *Walcottellas* were procured.

Respecting the systematic position of *Dielymella*, it is thought to be with *Indiana* Matthew on the one hand, and an unquestioned Phyllocarida like the Ordovician *Caryocaris* and the Devonian *Elymocaris*, on the other. Of course there is a wide structural interval between these two extremes, but *D. recticardinalis*, especially the variety *angustata*, seems to fairly represent an intermediate stage. These Cambrian bivalved crustacea are in a way synthetic, their modifications tending generally in two directions, one toward the leperditoid Ostracoda, the other toward the ceratiocarid Phyllopoda. *Dielymella* illustrates a modification toward the latter type, while *Indiana* and

certain species of *Walcottella* trend in the opposite direction toward the Leperditian type. Neither is believed to be a link in a true genetic chain, and the latter is probably merely prophetic or suggestive of a subsequent evolutionary departure from the same synthetic stock that finally culminated in the Leperditiidae. In the case of *Dielymella*, this is probably only an abortive expression of the tendency of the old stock to modify in the direction of the ceratiocarid carapace, since the true line of the latter had been established already in middle and early Cambrian times.

The small impressions in the umbonal part of the casts of the interior, satisfactorily seen only in the genotype, are thought to be comparable in a broad way to the impressions of the rostral clavicles and muscles seen in the Ordovician bivalved crustacean genera *Technophorus* and *Ischyrina*.[9] These pelecypodlike shells are related to *Ribeiria* and similar types of presumed crustacea occurring in the rocks of Beekmantown and Ozarkian ages, which in part close the obvious gap between *Technophorus* and *Dielymella*.

Considering generic characters, *Dielymella* is distinguished from *Indiana* by the greater development and more prowlike shape of the anterior part and the wider gape of the valves. In that genus the antero-cardinal angle is generally rounded off and never beaklike, as it commonly is in *Dielymella*.

DIELYMELLA RECTICARDINALIS, new species

Plate 10, Figures 3–7

Description.—Carapace podlike, the greatest height and length respectively as 7 or 8 is to 12; hinge line long, straight, terminating abruptly at the truncated anterior extremity, but passing gradually into the curve of the posterior extremity; antero-cardinal angle obtusely beaklike, the angle of the anterior and cardinal sides approximately 90°; remainder of outline curved, the posterior part narrowly, with the most prominent point above the mid-height, the ventral part a more or less nearly regular elliptic curve. Commonly a slight increase in rate of curvature is noted in the antero-ventral part. Valves moderately convex, without nodes of any kind, the highest point somewhat above and slightly in front of the middle; edge usually simple; but some valves exhibit a narrow band along the ventral margin, probably due to a delicate, raised line on the inner surface and a slight marginal thickening of the inner edge; anterior and dorsal slopes of casts of the interior usually increasing suddenly just before reaching the edge, this fact causing a bluntness not

[9] These genera have been described as pelecypoda. The doubt as to the systematic position of these shells raised by Ulrich in 1894 (The Lower Silurian Lamellibranchiata of Minnesota, p. 613) has been strengthened by further study, so that it is now regarded as practically settled that they are bivalved crustacea and not Pelecypoda.

observed at the posterior edge, and at least less evident on the ventral side. Gape of valves narrow, nearly uniform in width in the anterior and ventral parts, but expanding slightly in the posterior. Most of gape made up by the right valve. Test thin, black to light gray, usually exfoliated, the outer surface rarely seen, distinctly punctate when preserved.

Dimensions of rather large example: Greatest length, 10.0 mm.; greatest height, 6.2 mm.; greatest thickness of single valve, about 2.0 mm.; of entire carapace, about 4.2 mm.

By far the most of the specimens studied retain both valves, which, considering the coarseness of the sandy matrix, probably indicates a strong hingement of the valves. As the hinge is not denticulated, and as the valves are not kept in place by overlap of their edges, it is assumed that comparatively strong muscles, probably located in the umbonal part, were responsible for their retention in place. The small depressions in the casts of the antero-dorsal angle are thought to indicate the lodgment of these muscles.

Occurrence.—Common in the Bright Angel shale, head of Nunkoweap Valley, Grand Canyon of the Colorado, Ariz. *D. nasuta* and *D. appressa* are comparatively rare at the same locality, but species of *Walcottella* were not observed.

Cotypes.—Cat. No. 56510, U.S.N.M.

DIELYMELLA RECTICARDINALIS ANGUSTATA, new variety

Plate 10, Figure 8

The interior cast of an entire carapace figured on Plate 10 is all that has been seen of this variety. It is considerably smaller than the average for specimens of the typical form of the species. That it is not merely a young stage of the typical variety is demonstrated by the figure of a smaller individual of the latter beside it on the same plate. (Fig. 7.) In the absence of other specimens, the writers hesitate to separate the individual under discussion as a distinct species, the subordinate designation above proposed being thought provisionally sufficient to cover the case.

On comparison the variety *angustata* is readily distinguished by its more elongate form, the length (7.0 mm.) being fully twice the height (3.5 mm.) whereas in the typical variety the height scarcely exceeds two-thirds of the length. In the former the anteroventral part of the outline is less prominent, the recession of the curve beginning nearer the dorsal angle. The posterior end also is somewhat different, the point at which the outline bends forward being opposite the mid-height instead of above it. All of these peculiarities might have been produced by accidental compression of the ventral half of the carapace; but as the specimen exhibits no evidence of such distortion, indeed, as none of the fossils from this bed seem to have suffered

appreciably from pressure, the suggested possible cause of the differences is discredited.

Occurrence.—Same as the preceding.

Holotype.—Cat. No. 56511, U.S.N.M.

DIELYMELLA NASUTA, new species

Plate 10, Figures 10, 11

Description.—Carapace somewhat obliquely acuminate ovate, the greatest height equaling about two-thirds the length; hinge straight, long, its extremities sharply defined, the posterior angle about 120°, the anterior less than 90°, prominent, obtusely claw-shaped; anterior end narrower than the posterior, straight or very gently concave in the upper half; the remainder of outline, from middle of anterior side to posterior extremity of hinge, a nearly regular elliptical curve, the narrowest part of which corresponds to the postventral margin. Valves strongly convex, attaining greatest thickness in anterior half; no border. Surface of shell usually appearing smooth but when well preserved exhibits minute and irregularly arranged punctae.

Dimensions of best specimen, a left valve, apparently of average size: Greatest horizontal length, 7.7 mm., length diagonally across valve from beak to postventral margin, 8.3 mm.; greatest height (just behind middle) 5.9 mm.; greatest thickness, single valve, about 2.7 mm.

Remarks.—In this species the anterior extremity is even more acuminate and beaklike than in *D. recticardinalis*. It differs from that species further in being proportionately much wider posteriorly and narrower anteriorly, in the more definite angularity of the postcardinal margin, and in being relatively shorter. All these differences apply again in comparing it with *D. appressa*, with the additional fact that the latter is less convex.

Occurrence.—Bright Angel shale. Bass Canyon and head of Nunkoweap Valley, Grand Canyon of the Colorado, Ariz.

Cotypes.—Cat. Nos. 56508, 56509, U.S.N.M.

DIELYMELLA APPRESSA, new species

Plate 10, Figure 9

Description.—Disregarding the truncation of the hinge line and the rectangular antero-cardinal region, the outline is elongate elliptical. The valves are compressed convex, the middle third of the profile, in a dorsal view, almost straight. Surface of test obscurely punctate or smooth; irregularly striated along the free margin.

Dimensions of a large carapace: Greatest length, 9.4 mm.; greatest height, 5.5 mm.; greatest thickness, 2.3 to 3.0 mm.

Remarks.—This species is easily separated from *D. recticardinalis* being less convex, wider posteriorly, and less prominent in the antero-

cardinal region. The surface of test also is less distinctly punctate or quite smooth, though this difference is not usually apparent, the shell being usually exfoliated. Young specimens resemble *D. dorsalis*, but the posterior margin in more uniformly curved. *D. nasuta* is more convex and its anterior extremity quite different in shape.

Occurrence.—Bright Angel shale; three specimens found associated with *D. recticardinalis* at head of Nunkoweap Valley, seven specimens at the Bass Canyon locality with numerous examples of *Walcottella;* Grand Canyon of the Colorado, Ariz.

Holotype.—Cat. No. 56506, U.S.N.M.

DIELYMELLA DORSALIS, new species

Plate 10, Figure 1

Description.—Carapace oblong, subquadrate, the ends nearly equal, the posterior slightly the wider and its outline most prominent in the dorsal half; hinge line very long, terminating abruptly at the rectangular front, postcardinal angle sharply rounded; ventral half of outline semielliptical. Surface of valves moderately convex with an obscure flattening in the mesial third of the dorsal half. An obscure elevation or node occurs near the antero-dorsal angle in the type specimen; but as it is slightly injured at this point, it is not possible to decide whether the node is a natural feature or accidental. Test somewhat exfoliated, apparently smooth.

Dimensions of a right valve: Greatest length, 4.2 mm.; height, 3.0 mm.; thickness, about 0.75 mm.

Remarks.—Unfortunately the unique example on which this species is founded is not quite perfect. As interpreted it is a right valve. Whether a right or a left, it is certain that the postdorsal part of its outline is more abruptly rounded and more produced than in any of the other species referred to this genus. Except in this respect, *D. dorsalis* is sufficiently like young examples of *D. appressa* to necessitate care in their discrimination. The flattening of the centrodorsal region, on the other hand, is so suggestive of the associated *Indiana impressa* that it is difficult to distinguish specimens with imperfect margins. Good specimens, of course, offer no difficulties, the dorsal half of the outline being quite different in the two species.

Occurrence.—Bright Angel shale, Bass Canyon, Grand Canyon, Ariz.

Holotype.—Cat. No. 56505, U.S.N.M.

DIELYMELLA BREVIS, new species

Plate 10, Figures 12, 13

Nothozoe? vermontana (part) WALCOTT, 10th Ann. Rep. U. S. Geol. Surv., 1890, pl. 80, figs. 4*a*, 4*b* (not fig. 4).

Not *Nothozoe vermontana* WHITFIELD, Bull. Amer. Mus. Nat. Hist., vol. 1, 1884, p. 414, pl. 14, figs. 14, 15.

Description.—Carapace large, relatively short, compressed convex; outline, excepting the antero-dorsal angle and the straight hinge, nearly circular; height a little less than four-fifths the greatest length, postdorsal angle very obtuse, anterior angle sharply defined, 85° to 90°; hinge line straight, its length nearly equaling the greatest height of carapace; anterior margin approximately straight and nearly vertical in the upper two thirds. Valves moderately convex, thickest in the antero-dorsal half in which part the slope to the outer edges is less gentle than toward the ventral and posterior sides. Test unknown, replaced in the specimens by a ferruginous coating of the interior cast.

Dimensions: Length 17.1 mm.; height, 14.2 mm.; length of hinge, 13.5 mm. Other specimens referred to this species range in length between 8 and 12 mm.

Remarks.—This species is founded chiefly on two opposite valves, both of which were somewhat poorly illustrated by Walcott and referred by him [10] to *Nothozoe vermontana* Whitfield. New figures, based on photographic prints of the originals, have been prepared for this work. Comparing these with Whitfield's figures of *N. vermontana*, it will be observed that the former are quite different from the latter, especially in the outline of the dorsal half.

While there is considerable reason for the retention of Whitfield's original specimens under *Nothozoe*, a similar course in the case of the specimens above described is manifestly unjustifiable. Their reference to *Dielymella*, though not entirely satisfactory, is yet within the range of a reasonable extension of the boundaries of this genus. The dominant external characteristics of the carapace of *Dielymella* such as the rectangular form of the antero-dorsal part of the outline, the straight hinge, the general curvature of the posterior margin, and the fullness of the anterior part of the surface, are all present in *D. brevis*. The habitat of *D. brevis* also seems to have been the same as that of all other species of the genus. It occurs in a coarse, quartzitic sandstone lithologically very similar to the bed of sandstone from which the preceding Arizona species were procured.

Compared with other species of *Dielymella*, apparently the principal and only striking difference is in a feature that, under ordinary circumstances, can not be given a greater significance than specific, namely, in the matter of relative length, this being greatly less in *D. brevis* than in the other forms referred to the genus.

Occurrence.—From a bowlder of quartzite found on Sunset Hill, near Lake Dunmore, Salisbury, Vt., and presumably derived from nearby Lower Cambrian ledges.

Cotypes.—Cat. No. 56504, U.S.N.M.

[10] 10th Ann. Rept. U. S. Geol. Surv., 1890, pl. 80, figs. 4*a*, 4*b*.

MONONOTELLA, new genus

Primitia? (part) MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 137.
Indiana (part) MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 461.

Description.—Carapace small, consisting of a single plate bent sharply along the back till the edges are brought nearly together at the ventral side, or possibly of two valves ankylosed along their dorsal edges; ends, especially the posterior, gaping rather widely; subfusiform in a lateral view, broadly rounded posteriorly and tapering anteriorly to an obtusely acuminate extremity; acuminate ovate in a dorsal view; sides strongly convex, without nodes of any kind. Test as in *Indiana*, black, thin, pliable, minutely punctate.

Genotype.—*Mononotella fusiformis* (*Primitia? fusiformis* Matthew).

Remarks.—But a single species having the characters ascribed to this new genus has been observed. This was described in 1895 by Matthew [11] under the name *Primitia? fusiformis*. In 1902 [12] the same author referred the species to his genus *Indiana*. The generic characters are taken from a nearly complete though somewhat crushed example in the United States National Museum, which was carefully compared and specifically identified with Matthew's original type of the species.

The most important addition to the knowledge of this species brought out by the study of the specimens in the National Museum is the apparent fact that its carapace, instead of being formed of two loosely hinged valves, as in the otherwise not very dissimilar species of *Indiana*, consists either of firmly united (ankylosed) valves or of a single plate bent so as to simulate the bivalved forms. The fact that the dorsal part of the test in the best specimen is not entire but shows a line of fracture leaves the matter of its supposed original unity still somewhat doubtful. However, the ragged nature of the line is regarded as strongly indicative of separation by fracture. It certainly differs from the usual appearance of the line dividing the dorsal edges of the valves in ordinary bivalved forms.

Aside from the supposed dorsal ankylosis of the valves, the carapace of *Mononotella* is not greatly different from that of *Indiana*. The gap between the incurved edges at the ends and the ventral side is much wider, and this doubtless is a valid generic character. The much greater anterior type is a conspicuous peculiarity, but as only a single species of *Mononotella* is known and as the form of the carapace is subject to considerable variation in different species of most genera of bivalved crustacea, it is impossible as yet to decide as to the degree of importance that should be ascribed to the difference.

None of the other genera of Cambrian Crustacea described in this work is closely allied. The British *Hymenocaris*, which has a folded,

[11] Trans. New York Acad. Sci., vol. 14, 1895, p. 137, pl. 8, figs. 3*a*, 3*b*.
[12] Canadian Rec. Sci., vol. 8, 1902, p. 461.

univalved carapace, possibly is not far removed, but the general aspect of its known parts differs so greatly from the present genus that anything like close affinities between the two seems highly improbable. While *Hymenocaris* is generally and probably correctly regarded as an early representative of the Phyllocarida, no such relation is believed to fit the case of *Mononotella*. This genus, on the contrary, seems too much like *Indiana* and its more immediate allies to permit of wide separation; hence, like those genera, its systematic position is believed to be with the Phyllopoda and nearer the Ostracoda than the Phyllocarida.

MONONOTELLA FUSIFORMIS (Matthew)

Plate 8, Figures 22–25

Primitia(?) fusiformis MATTHEW, Trans. New York Acad. Sci., vol. 14, 1895, p. 137, pl. 8, figures 3*a*, 3*b*.
Indiana fusiformis MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 461.

Description.—Carapace oblique, acuminate-ovate in lateral view, the anterior end tapering to an obtuse point, the posterior half comparatively broadly rounded, semielliptic, the post dorsal angle obtuse but causing an appreciable angulation about the middle of the dorsal half of the outline; dorsum nearly straight; ventral part of outline very gently convex until it begins to turn rapidly upward around the posterior end. Sides (?valves) strongly convex, turned inward along the edges; gap wide at the ends, especially so at the posterior, narrowing from either end toward the middle of the ventral side. Test thin, black, minutely punctate; punctae rather closely arranged, but not sufficiently so to suggest reticulation.

Dimensions of a nearly complete carapace: Greatest length about 7.0 mm., greatest width (at right angles to greatest length) 4.0 mm., greatest thickness about 4.0 mm.

Remarks.—The single example (a left valve) of this species in the Matthew collection of types is so different in its outline from all the other Cambrian Conchostraca that it was recognized at once. The narrower and almost acute anterior extremity characterizing the species, while not perfectly preserved in the type specimen, is yet very nearly complete. From this species alone it was not possible to decide as to which is the ventral and which the dorsal side. Matthew referred to it somewhat doubtfully as a right valve, but on comparison with a more complete carapace, it proved to be a left side. Matthew based his view chiefly on what he took to be obscure eye tubercles, and a shallow groove running from them two-thirds across the valve. He noted further a filiform fold at the posterior margin. None of these features, however, is believed to be normal. On the contrary, they are thought to have been effected by accidental distortion of the pliable test. Similar fortuitous elevations and grooves are common

in specimens of otherwise very different Cambrian species studied in the course of this work.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*3). Matthew's type is from Hanford Brook, St. John County, New Brunswick. Specimens in the United States National Museum are from the same locality and probably from the same beds. A single example (E3*b*), doubtfully referred to the species, came from the Etcheminian at Dugald Brook, Cape Breton, Nova Scotia.

Plesiotype.—Cat. No. 56499, U.S.N.M.

Family LIMNADIIDAE Baird

Genus LEPIDITTA Matthew

Lepiditta MATTHEW, Trans. Royal Soc. Canada, vol. 3, sec. 4, 1886, p. 61.—MILLER, North Amer. Geol. and Pal., 1889, p. 553.—MATTHEW, Trans. New York Acad. Sci., vol. 15, 1896, p. 194.

Description.—Carapace small, a millimeter or two in length bivalved, obliquely semielliptical or semicircular, narrow and more or less acuminate posteriorly, wider and nearly rectangular anteriorly, with the hinge straight and extending the full length of the valves. Surface moderately convex, usually with a low, conical, umbonelike elevation near or in front of the middle of the dorsal edge. Test thin, composition doubtful, probably calcareous; externally marked with concentric lines or undulations and sometimes with minute radial lines rarely smooth. Casts of the interior exhibit a short, vertical fissure or depression suggesting a clavicle on inner side of shell.

Genotype.—*Lepiditta alata* Matthew. Middle Cambrian.

Remarks.—The systematic position of this genus is somewhat doubtful. The shell being usually dissolved away in the shales, it is thought likely to have been more calcareous than in the great majority of Cambrian bivalved Crustacea. In this respect then it would appear to agree with *Fordilla* in which the shell is known to be highly calcareous. It agrees further with that genus in presenting an aspect simulating that of a minute pelecypod. These peculiarities suggest the phyllopod genus *Estheria* more than any other bivalved crustacean known, and the resemblance is believed to be sufficient to warrant the provisional reference of these two Cambrian genera to the Limnadiidae. The principal objection to this arrangement lies in the fact that Crustacea like *Estheria* are almost if not entirely unknown in rocks older than Devonian. A possible exception is *Orthonotella faberi* Miller, described as a pelecypod, which is found in the upper part of the Ordovician at Cincinnati, Ohio. Other possible exceptions are *Ischyrina* and *Technophorus*, both founded on Ordovician species hitherto referred to the Pelecypoda.

The separated valves of the Middle Devonian genus *Schizodiscus* Clarke agree so closely with those of *Lepiditta* that it is really difficult

to point out satisfactory differences. The carapace of *Schizodiscus*, however, is supposed to be peltate, while in *Lepiditta* the two valves are thought to have closed as in *Estheria*. Compared further with the latter genus *Lepiditta* differs in the form of its valves, these being much narrower and subacuminate instead of rounded, posteriorly; and the concentric markings of the shell are less regular and not ridgelike. The small interior clavicle in front of the umbones is an interesting reminder of a similar feature in *Ribeiria*, *Ischyrina*, and *Technophorus*.

Only two of the four species referred to this genus by Matthew are regarded as strictly belonging here. These are his *L. alata* and *L. curta*. The other two, *L. auriculata* and *L. sigillata*, are each represented by a single example that in neither case is sufficiently good to encourage an attempt at final classification. Provisionally they must be viewed as doubtful species.

A possible third good species is indicated by Steusloff's *Bythocypris polita*. As figured and described, this species agrees very well with *L. alata* in general aspect, but differs in its smooth, polished shell and in the unusual abruptness of the ventral slope. As it is most certainly not a *Bythocypris*, it is removed provisionally to *Lepiditta*.

LEPIDITTA ALATA Matthew

Plate 7, Figures 24, 25

Lepiditta alata MATTHEWS, Trans. Royal Soc. Canada, vol. 3, sec. 4, 1886, p. 61, pl. 6, figs. 16, 16*a*; Trans. New York Acad. Sci., vol. 15, 1896, p. 194, pl. 15, figs. 1*a*, 1*b*.

Description.—Valves obliquely semielliptical, broad and rectangular on the anterior side, narrowing posteriorly; hinge straight, extending the full length of valves. Surface moderately convex, marked by numerous, rather regular but not very sharply defined concentric lines. These center at the small umbonal elevation which is located just within the dorsal edge and approximately one-third of the length of the hinge behind the anterior angle. Very delicate lines radiating from the umbo observed on a cast of the exterior. In casts of the interior the umbo is more prominent than on the exterior and the clavicle causes a small, sharp, sometimes fissurelike, vertical depression just in front of it.

Dimensions: Length, 1.15 mm.; greatest height 0.89 mm.

Remarks.—The above description is based on the specimens selected by Matthew as the types of his species. Except that they do not preserve the test, they are in good condition; and being molds of the two surfaces of the shell, internal characters are seen that are not usually visible. One of the molds of the exterior surface shows two obscure radial ridges disposed somewhat as in the Pennsylvanian *Leaia leidyi*. Although these obscure radial ridges are to be observed

on most of the specimens, they are not mentioned in the description because there is ground for the suspicion, if not the conviction, that they are at least in part due to compression.

Occurrence.—Middle Cambrian (Acadian): In the fine gray shales of division C1c2 of Matthew's section at Hanford Brook, St. Martins, New Brunswick.

LEPIDITTA CURTA Matthew

Plate 5, Figures 18, 19, Plate 7, Figure 29

Lepiditta curta MATTHEW, Trans. Royal Soc. Canada, vol. 3, sec. 4, 1886, p. 62, pl. 6, fig. 17; Trans New York Acad. Sci., vol. 15, 1896, p. 195, pl. 15, fig. 2.

Description.—Valves obliquely semielliptical or subtriangular, with the length and height, respectively, about as 10 is to 7; hinge straight, the remainder of the outline rather gently curved except at the antero-ventral angle, where it is sufficiently rapid to suggest the word triangular in speaking of the outline. Surface now depressed convex, originally probably rather strongly convex, marked with five or six unequal concentric undulations. Umbo inconspicuous, situated about one-fourth of the length of the hinge line behind the front angle.

Dimensions: Length, 1.50 mm.; height, 1.02 mm.

Remarks.—Only the two specimens marked by Matthew as the types of the species have been seen. Matthew speaks of the interior of the shell as having "roughened zones or undulations concentric to the umbo." As the types retain very little of the shell and are merely impressions of the exterior slightly roughened by remains of the decomposed shell, the observation applies to the exterior rather than to the interior. Respecting the affinities of the species, there can be no reasonable doubt of its close reltations to *L. alata*. So far as shown by the specimens, it differs from that species only in being a little larger, relatively shorter and more triangular in shape and in having fewer and coarser concentric undulations of the surface. Radial lines, aside from those due to compression, are very obscurely indicated.

Occurrence.—Middle Cambrian (Acadian): In the fine dark shales of division C1*d* of Matthew's section at Porters Brook, St. Martins, New Brunswick.

LEPIDITTA? POLITA (Steusloff)

Plate 7, Figure 28

Bythocypris polita STEUSLOFF, Zeits. d. d. geol. Gesell., vol. 46, 1894, p. 775, pl. 58, fig. 31.

This species is known only from the description and figures published by Steusloff. Judging from these the valves are obliquely semielliptical, the anterior side descending rectangularly from the long, straight hinge, the posterior side narrower and relatively acuminate at the dorsal angle. Near the middle of the dorsal edge, two widely diverg-

ing, linear depressions outline a low, umbonelike elevation. The surface is smooth and polished and slopes more aburptly to the ventral and anterior edges than to the dorsal and posterior margins. The length is given as 0.8 mm., the height as 0.4 mm.

Occurrence.—Limestone probably Middle Cambrian in age, containing besides *Acrothele* species and *Parabolina* species. Drift, Neue Brandenberg, Germany.

DOUBTFUL SPECIES

LEPIDITTA? AURICULATA Matthew

Plate 5, Figure 20, Plate 7, Figure 26

Lepiditta auriculata MATTHEW, Trans. Royal Soc. Canada, vol. 11, sec. 4, 1894, p. 99, pl. 17, figs. 2*a*, *b;* Trans. New York Acad. Sci., vol. 15, 1896, p. 196, pl. 15, figs. 3*a*, 3*b*.

The type of this species is most certainly not a congener of the two preceding typical species of *Lepiditta*. Indeed, it is thought highly improbable that it is a bivalved crustacean at all. Its mode of preservation and general appearance is the same as that of the associated trilobites, while the form, and especially the symmetrically bilateral arrangement of its parts, suggests nothing else so much as the hypostoma of some trilobite.

Matthew calls it a left valve and speaks of "two groves in the mold at the hinge line showing that the hinge had two oblique plates or teeth towards the posterior end." The grounds for determining it to be a left valve and not a right are not stated, and close examination has failed to show anything even suggesting such a thing as the supposed hinge teeth.

Occurrence.—Middle Cambrian (Acadian). In division C1*c*1 of Matthew's section at Hanford Brook, New Brunswick.

LEPIDITTA? SIGILLATA Matthew

Plate 5, Figure 21; Plate 7, Figure 27

Lepiditta sigillata MATTHEW, Trans. Royal Soc. Canada, vol. 11, sec. 4, 1894, p. 98, pl. 17, fig. 1; Trans. New York Acad. Sci., vol. 14, 1895, p. 138, pl. 8, fig. 8.

The type and only known representative of this species, while unquestionably one side of a bivalved crustacean, seems no less certainly not congeneric with *L. alata*. The present shape of the specimen is much like that of a true *Lepiditta*, but after a careful investigation the conclusion that it resulted through distortion of the dorsal part seemed inevitable. The ventral part of the specimen apparently was not greatly affected, but the back has been crushed and turned in on itself—a condition that, considering the pliability of the test in most of these Cambrian bivavlves, is not at all extraordinary. Many

similar instances of partial distortion were observed in the course of these studies. Matthew's statement concerning a "narrow, oblique tooth or ridge inside the shell at the hinge line" proves to be based on a crumpling of the test at this point and not on a structural feature of the hinge. The marking of the surface by "two diverging rows of shallow impressions" and the "small round tubercles" seem both to be somewhat fanciful interpretations of what are believed to be merely accidental indentations of the inner and outer surfaces of the test by grains of sand.

The composition of the test is not the same as in true *Lepiditta* but agrees essentially with that of the shell of *Bradoria* and *Beyrichona*. Being convinced that the dorsal half of the type of *L. sigillata* has been crushed almost out of existence, a comparison of the remaining ventral half with corresponding parts of species of *Bradoria* and *Beyrichona* brought out the fact that in at least one of the species of the latter genus, namely, *Beyrichona planata*, the lower half of the valve corresponds exactly with the specimen under discussion. The probability thus suggested may be satisfactorily tested by covering, somewhat obliquely, the upper part of Figure 4 on Plate 6, and comparing the remaining portion with the enlarged photograph of *L. sigillata* on Plate 7. In corroboration it remains to be said that *L. sigillata* came from the same stratigraphic division, if not the same layer, as *B. planata*.

Occurrence.—Lower Cambrian (Hanfordian, division C1*b*3); Hanford Brook, New Brunswick.

Genus FORDILLA Walcott

Fordilla WALCOTT, Bull. U. S. Geol. Surv., No. 30, 1886, p. 123.—MILLER North Amer. Geol. and Pal., 1889, p. 480.

Although closely resembling a pelecypod in outline, the interesting species upon which *Fordilla* is based has the calcareo-phosphatic structure of genera here referred to the Limnadiidae. The type species has been described in detail by various authors and we have noted our idea of its relationships in the discussion of *Lepiditta*.

Genotype.—*Fordilla troyensis* Barrande. Lower Cambrian.

FORDILLA TROYENSIS Barrande

Plate 4, Figures 14, 15

Fordilla troyensis BARRANDE, Acephales: Ext. Syst. Sil. du Centre Boheme, 1881, Expl. pl. 361.—WALCOTT, Bull, U. S. Geol. Surv., No. 30, 1886, p. 125, pl. 11, figs. 3, 3*a*–*c*; Amer. Jour. Sci., ser. 3, vol. 34, 1887, p. 192.—SHALER and FOERSTE, Bull. Mus. Comp. Zoöl., No. 16, 1888, p. 29, pl. 1, fig. 4.—LESLEY, Geol. Surv. Pa. Rept., p. 4, 1889, p. 251, 4 text figs. only.—MILLER, North Amer. Geol. and Pal., 1889, p. 480, text fig. 825.—WALCOTT, Tenth Ann. Rept. U. S. Geol. Surv., 1890, p. 615, pl. 73, figs. 1?, 2, 2*a*–*c*.

We have no new observations to add to the description of this species save the remarks as to the classification of the genus given above. *Lepiditta alata*, *Modioloides prisca*, and the present species seem to us related but in each case more material for study is needed.

Occurrence.—Lower Cambrian, Troy, New York.

Genus MODIOLOIDES Walcott

Modioloides WALCOTT, Amer. Journ. Sci., ser. 3, vol. 38, 1889, p. 29.

The single specimen representing the genotype and only species of this genus is the cast of a valve which on account of the presence of a muscular scar at the anterior end just within a supposed pallial line caused its reference to the pelecypoda. The shell structure is calcareo-phosphatic as in *Fordilla* and allied genera, so that *Modioloides* is very probably a crustacean best referred, with present knowledge, to the Limnadiidae.

Genotype.—*Modiolopsis? prisca* Walcott. Lower Cambrian.

MODIOLOIDES PRISCA (Walcott)

Plate 4, Figure 16

Modiolopsis? prisca WALCOTT, Amer. Journ. Sci. Arts, ser. 3, vol. 34, 1887, p. 191, pl. 1, fig. 19.

Modioloides prisca WALCOTT, Tenth Ann. Rep. U. S. Geol. Surv., 1890, p. 615, pl. 73, fig. 3.

Our unretouched photograph of the type specimen indicates that the oval muscle scar at the supposed anterior end is possibly due to a crushing of the test, a condition very commonly found in the Cambrian Conchostraca. At any rate, more material is necessary before the relations of this interesting fossil can be established.

Occurrence.—Lower Cambrian; Whitehall, Washington County, N. Y.

SPECIES OF UNCERTAIN AFFINITIES

ENTOMIDELLA(?) BUPRESTIS (Salter)

Plate 8, Figures 20, 21

Leperditia buprestis SALTER, British Ass. Rep., Trans. Sec., 1865, p. 285.

Entomis buprestis JONES, Quart. Journ. Geol. Soc. London, vol. 28, 1872, p. 183, pl. 5, fig. 15.

Entomidella buprestis JONES, Ann. and Mag. Nat. Hist., ser. 4, vol. 11, 1873, p. 417.

Leperditia punctatissima SULTI, Siluria, app. 1865, p. 519.

Remarks.—This peculiar species apparently is known as yet only from the specimen originally described by Salter. A photographic reproduction of Jones's figure of this specimen is given on Plate 8. The descriptive remarks published by Salter and later by Jones are in both instances exceedingly unsatisfactory. The valves are represented as "very elongate ovate" but their borders are said to be "partly embedded" in the matrix: and the surface of the "pyritous"

tests is beautifully pitted. Each of the separated valves is crossed by a nearly vertical fracture, marking, according to Jones, a furrow. The length of the valves is about 9.0 mm., the height about 3.0 mm. The type specimen was found in the Menevian at St. Davids, Wales.

This species and *Entomis divisa* Jones were made the genotypes of the new genus *Entomidella* by Jones in 1873, although later he regarded *E. divisa* as the genotype, and still later rejected *Entomidella* as a synonym of *Entomis*. That this Cambrian fossil is really a congener of the Silurian *Entomis* or *Entomidella divisa* seems highly improbable. Throughout his long work on fossil bivalved Crustacea Jones was ever too ready to minimize or overlook highly important discrepancies in structure. Numerous instances illustrating this tendency might be cited. Unfortunately, in the present case, positive data are lacking; but relying on the illustration and meager notes on *E. bupres-tis* published by Jones, there is strong ground for the suspicion that the Cambrian species is a very different thing from its supposed Silurian congener. That the transverse fracture of the valves of the former represents the long curved furrow of an *Entomis* is especially doubtful. It is thought further that the composition of the test, a factor apparently never considered by Jones, will prove widely different in *E. bupestris* and *E. divisa*. Until an adequate description of *E. bupestris* is published the species must remain among the uncertain forms.

A single valve in the United States National Museum (Cat. No. 56501), apparently somewhat compressed vertically and incomplete at one end, is similar in shape and size to *E. ? buprestis*. It was collected by Doctor Walcott at Hanford Brook, St. John County, New Brunswick, from C1*b*2 of Matthew's Protolenus zone. Except for the fact that it exhibits no sign of a vertical furrow it might be referred to Salter's species. Possibly it is a distorted and anteriorly incomplete example of *Mononotella fusiformis*, but the parallelism of its dorsal and ventral margins is thought to positively negative that view. For the present it is left unclassified.

Occurrence.—Middle Cambrian (Menevian): St. Davids, Wales. Doubtfully present in the Lower Cambrian (Hanfordian, C1*b*2) of New Brunswick.

Genus LEPIDILLA Matthew, 1886

Lepidilla MATTHEW, Trans. Royal Soc. Canada, vol. 3, sec. 4, 1886, p. 62.—MILLER, North Amer. Geol. and Pal., 1889, p. 553.

Bivalve? shell having the hinge and body of the valve or plate in different planes. Hinge line straight projecting from the general contour of the shell. Umbo and hinge line separated from the body of the valve by a sinus or emargination behind which is a foramen. (Matthew, 1886.)

Genotype.—*Lepedilla anomla* Matthew. Middle Cambrian.

LEPIDILLA ANOMALA Matthew

Plate 7, Figures 20–23; Plate 5, Figure 17

Lepidilla anomala MATTHEW, Trans. Royal Soc. Canada, vol. 3, sec. 4, 1886, p. 62, pl. 6, figs. 18*a–c*; vol. 8, 1891, p. 130, pl. 11, fig. 2.

We have refigured the type and only specimen of this species, which is in such a state of preservation that the real affinities can not be determined without a study of additional material. Matthew has brought out the essential features in his generic description, which is copied above.

Occurrence.—Middle Cambrian (Acadian, C1*c*2): Hanford Brook, New Brunswick.

"LEPERDITIA" VENTRICOSA Matthew

Plate 7, Figure 35

Leperditia ventricosa MATTHEW, Trans. Royal Soc. Canada, vol, 7, sec. 4, 1890, p. 159, pl. 7, figs. 12 *a–d*; Trans. New York Acad. Sci., vol. 14, 1895, p. 137, pl. 8, figs. 5*a–5d*.

Isochilina ventricosa MATTHEW, Canadian Rec. Sci., vol. 8, 1902, p. 453.

This species is represented in the Matthew collection of types by two imperfect specimens, one a valve, the other the impression of same or another valve in the hard sandstone matrix. One margin is fairly well preserved and shows a broad, thick flange. The remaining portions of the outline are not in condition to prove that this flange extends around the whole of the free margins, but judging from the general preservation of the specimens, it is thought likely that if it had, more of the flange would have been retained. As preserved the shape is irregularly subovate, the hinge nearly straight, the dorsal angles not very conspicuous. The surface is strongly convex and entirely covered with a network, the meshes of which increase greatly in size toward the middle of the valve, where they are easily visible to the naked eye. The shell is thin, and its composition apparently the same as in *Bradoria* and allied genera. The length is about 8.0 mm., the height about 6.5 mm.

There is nothing about this valve suggesting even remote alliance to *Leperditia*, or to *Isochilina*, as supposed by Matthew. The composition of the valve is as in the Bradoriidae, and hence quite different from the much more calcareous shells of Ostracoda. Obscure tubercles are noted near one of the angles, but they are too indefinite to be compared with those in *Bradoria*. Still, this feature might be waived and the species referred to that genus were it not for the thick anterior (?) flange. Under the circumstances it is thought probable that *L. ventricosa* will finally be referred to an as yet undescribed genus.

The character of the surface ornamentation, especially the fact that the pits, or the meshes of the network, increase in size inward from the margins, seems to be exactly the same as in the even more

obscure "*Leperditia ebenina*" of Dwight. Possibly the two are of the same species, which is not improbable, since they are alike in size. However, their exact relationship can not be established with the evidence now available.

Occurence.—Lower Cambrian (Hanfordian, division C1*b*1): Hanford Brook, St. Martin's New Brunswick.

"LEPERDITIA" EBENINA Dwight

Plate 7, Figures 33, 34

Leperditia ebenina DWIGHT, Amer. Journ. Sci., sec. 3, vol. 38, 1889, p. 144, pl. 6, figs. 2–4; Trans. Vassar Bros. Inst., vol. 5, 1890, p. 104, pl. figs. 2–4.

The collection of the United States National Museum contains but a single badly crushed and incomplete example of this species. It was collected by Professor Dwight and presumably belonged to the material on which he based the species. Judging from the figures published by Dwight none of the type specimens is in satisfactory condition. It is represented as transversely subelliptical or semiovate in outline, with a rather long, straight hinge, sharply defined dorsal angles, subequally rounded ends and more gently convex ventral edge. There is some indication of a wide marginal rim and the surface of the valves was probably rather strongly convex. However, in the present flattened condition of the specimens neither of these features is satisfactorily determinable. The most striking characteristic is that the pits of the reticulated surface ornament beginning with very minute sizes along the margins, gradually increase in size toward the middle of the valve, where over a considerable space they are visible to the unassisted eye. This peculiarity is shared by only one other Cambrian species, namely, the scarcely better known *Leperditia?? ventricosa* Matthew. As both are about equal in size, it is not improbable that they represent one and the same species. Until better specimens have been found neither can be regarded as an established species. It is needless to say that they do not belong to *Leperditia*.

Occurrence.—Middle Cambrian, thin bedded limestone, Stissing, Dutchess County, N. Y.

"LEPERDITIA" CAPSELLA Chapman

Plate 10, Figure 17

Leperditia capsella CHAPMAN, Proc. Roy. Soc. Victoria, vol. 31, new ser., pt. 1, 1918, p. 111 pl. 9, fig. 4.

The illustration of this species is included herewith to complete the list of Cambrian forms, although the correct generic position can not be determined at present.

Occurrence.—Upper Cambrian, Archeocyathina limestone: Curramulka, South Australia.

"LEPERDITIA" TATEI Chapman

Plate 10, Figures 14–16

Leperditia tatei CHAPMAN, Proc. Roy. Soc. Victoria, vol. 31, new ser., pt. 1, 1918, p. 109, pl. 9, figs. 1–3.

A reexamination of the type specimens is necessary before the affinities of this species can be determined. Possibly more than one species is represented among the specimens figured.

Occurrence.—Upper Cambrian, Archeocyathina limestone: Curramulka, South Australia.

"LEPERDITIA" cfr. SOLITARIA Barrande

?Leperdita solitaria BARRANDE Suppl. Sil. Syst., p. 532, pls. 23, 24 (Etage E).
Leperditia cfr. *solitaria* BURR, Amer. Geol., vol. 25, 1900, p. 47.—GRABAU, Boston Soc. Nat. Hist., Occ. Paper 4, pt. 3, 1900, p. 661.

The above references are inserted to indicate the occurrence of a member of the Conchostraca in Massachusetts, although no illustrations of it have been published.

Occurrence.—Cambrian, North Attleboro, Mass.

"LEPERDITIA" VEXATA Hicks

Leperditia? vexata HICKS, Quart. Journ. Geol. Soc. London, vol. 27, 1872, p. 396.
Larval trilobite? JONES, Quart. Journ. Geol. Soc. London, vol. 28, 1873, p. 184, pl. 5, figs. 17, 18.

The doubt as to the position of this form is indicated in the synonymy.

Occurrence.—Middle Cambrian (Menevian): St. Davids, Wales.

"ISOCHILINA" SWEETI Chapman

Plate 10, Figure 18

Isochilina sweeti CHAPMAN, Proc. Roy. Soc. Victoria, vol. 31, new ser., pt. 1, 1918, p. 111, pl. 9, fig. 5.

The generic affinities of this species, like the preceding, can not be determined without a study of actual specimens.

Occurrence.—Upper Cambrian, Archeocyathina limestone: Curramulka, South Australia.

MODIOLOPSIS THECOIDES Matthew

Plate 1, Figure 34

Modiolopsis thecoides MATTHEW, Bull. Nat. Hist. Soc., New Brunswick, vol. 4, pt. 3, No. 18, 1899, p. 191, pl. 1, figs. 7*a–c*; Trans. Roy. Soc. Canada, ser. 2, vol. 5, sec. 4, 1899, p. 103, pl. 5, figs. 7*a–c*.

Only the right valve is known; it is remarkable for its long, narrow shape and earlike anterior end. When this is concealed the shell is easily mistaken for a *Hyolithes*, the form of the posterior end and the

sculpture of the surface being like the dorsal side of a tube of that genus. The shell is about 9 mm. long and 4 mm. wide. (Matthew, 1899.)

The type specimen of this species is apparently lost for it is not present in any of the Canadian collections. As no other examples are known to us, the position of the species can not now be determined. The illustration is probably not that of a pelecypod, but possibly represents a worn *Hyolithes*.

Occurrence.—Lower Cambrian (Etcheminian): Newfoundland.

PRIMITIA SIMPLEX LLOYDIANA Jones

Primitia simplex var. *lloydiana* JONES, Ann. Mag. Nat. Hist., ser. 5, vol. 8, 1881, p. 348, pl. 20, fig. 2.

This supposed Cambrian variety of an Ordovician species can not be recognized with present information.

Occurrence.—Cambrian: St. John's, Newfoundland.

PRIMITIA SIMPLEX MILNEANA Jones

Primitia simplex var. *milneana* JONES, Ann. Mag. Nat. Hist., ser. 5, vol. 8, 1881, p. 348, pl. 20, fig. 3.

Not recognizable without further study of the types or topotypes.

Occurrence.—Cambrian: St. John's, Newfoundland.

PRIMITIA SIMPLEX SANCTOJOHANNESIANA Jones

Primitia simplex var. *sanctojohannesiana* JONES, Ann. Mag. Nat. Hist., ser. 5, vol. 8, 1881, p. 348, pl. 20, fig. 1.

Like the above, not recognizable.

Occurrence.—Cambrian: St. John's, Newfoundland.

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EXPLANATION OF PLATES

PLATE 1

Unless otherwise stated, all the figures on this plate are copied from Matthew's work and represent his figured types, to which, in almost all cases, we have had o restrict his species.

Page

FIGURES 1–5. *Bradoria robusta* Matthew (see also pl. 2, figs. 1–4) 22
1. *Aparchites robusta* Matthew, × 4 (C1*b*).
2. *Leperditia rugosa* Matthew, × 4 (E3*f*).
3. *Bradorona perspicator maxima* Matthew, × 4 (E1*c*).
4. *Bradorona perspicator major* Matthew, × 4 (E3*f*).
5. *Bradorona perspicator magna* Matthew, × 4 (E2*b*).

6–9. *Bradoria perspicator* Matthew (see also pl. 3, fig. 12) 24
6. *Bradoria perspicator* Matthew, × 4 (E1*d*).
7. *Bradoria observator* Matthew, × 4 (E1*d*).
8, 9. Outlines of the types of *Bradoria perspicator* Matthew, × 5 (E1*d*).

10. *Bradoria cambrica* Matthew, × 6 (C1*b*3) (see also pl. 3, figs. 14, 15) 28

11, 12. *Bradoria scrutator* Matthew (see also pl. 3, fig. 11) 14
11. The type, a left valve, × 6 with ventral portion hidden by matrix (E3*e*).
12. *Bradoria observator ligata* Matthew, × 4 (E3*e*).

13, 14. *Bradoria oculata* Matthew 16
Left valve of the type, × 6 and dorsal view of the entire carapace (C1*b*3).

15. *Bradoria vigilans* Matthew. Right valve, × 6 (E3*e*) 16

16. *Bradoria* (*observator* var.) *benepuncta* Matthew, × 4 (E1*d*) (see also pl. 2, figs. 6, 7, pl. 3, fig. 7) 18

17. *Bradoria rugulosa* Matthew, × 4 (E3*e*) 21

18. *Bradoria* (*Indiana*) *ovalis* Matthew, × 5 (E1*e*, E3*e*) (see also pl. 3, fig. 6) 21

19. *Bradoria* (*Bradorona*) *spectator* Matthew, × 4 (E1*c*) 25

20, 21. *Bradoria spectator spinosa* Matthew 26
20. The type specimen, × 4 (E1*c*).
21. Type of *Bradorona spectator aequata* Matthew, × 4 (E3*d*).

22. *Bradoria* (*Leperditia*) *minor* Matthew, × 5 (C1*b*3) 29

23. *Bradoria* (*Leperditia*) *steadi* Matthew, × 1 (C1*b*1) 29

24. *Bradoria ornata* Matthew, × 6 (E1*c*) 30

25. *Bradoria* (*Schmidtella*) *acuta* Matthew, × 6 (E3*c*) (see also pl. 3, figs. 1, 2) 19

26. "*Schmidtella? pervetus*" Matthew, × 6 (E3*e*). Too poorly served to be recognized 27

27. *Bradoria* (*vigilans* var.) *obesa* Matthew, × 6 (E1*b*) (see also pl. 3, fig. 13) 27

28. *Bradoria* (*aurora*) Matthew?, × 4 (C1*b*1) 30

29. *Bradoria* (*Beyrichia*) *primaeva* Matthew, × 4 (C1*b*2) 29

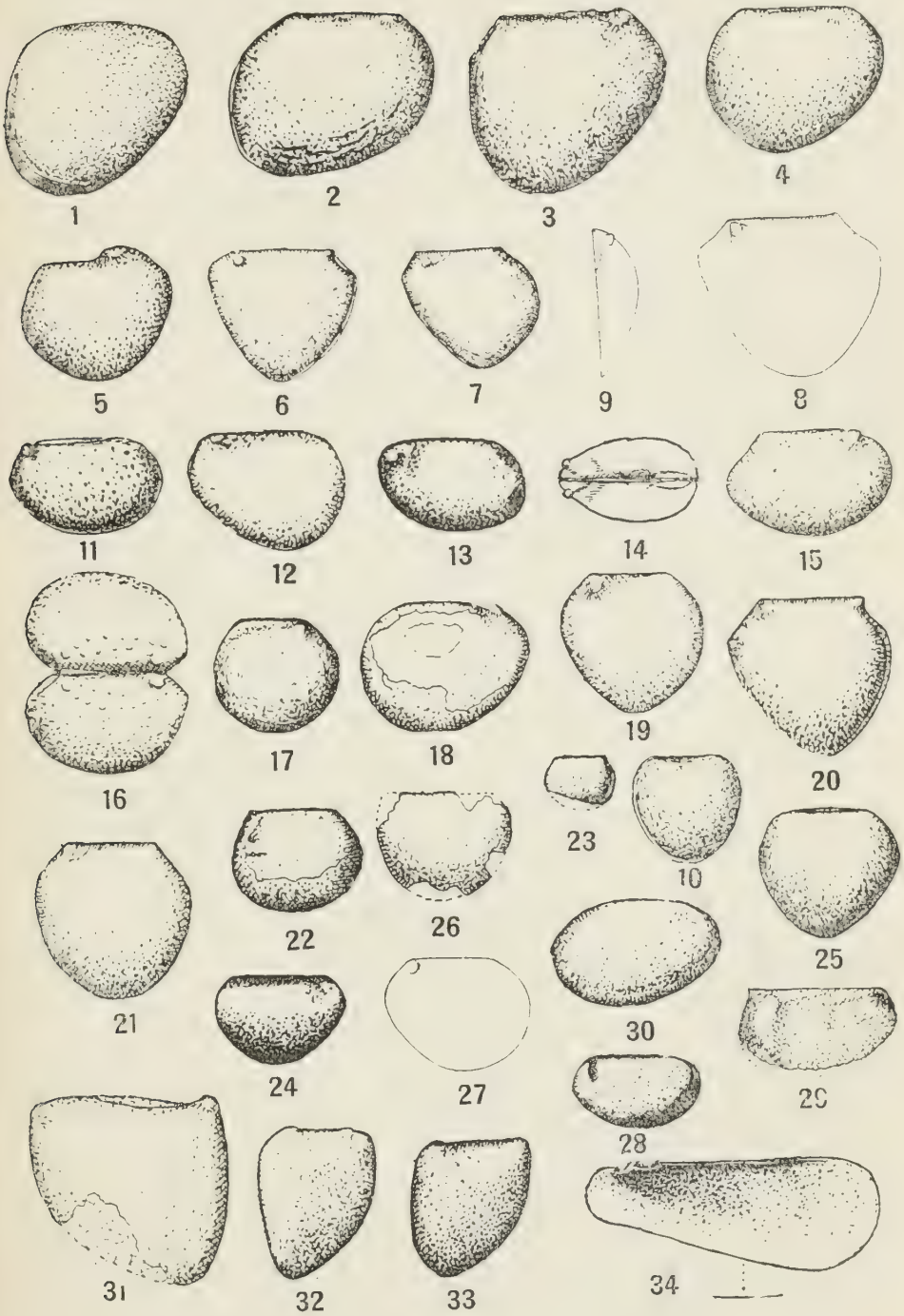
30. *Indiana ovalis prima* Matthew, × 4. Lower Cambrian (Coldbrookian) 21

31. *Escasona ingens* Matthew, × 4. Lower Cambrian (Coldbrookian) 48

32. *Escasona rutellum* Matthew, × 5 (E3*f*) 48

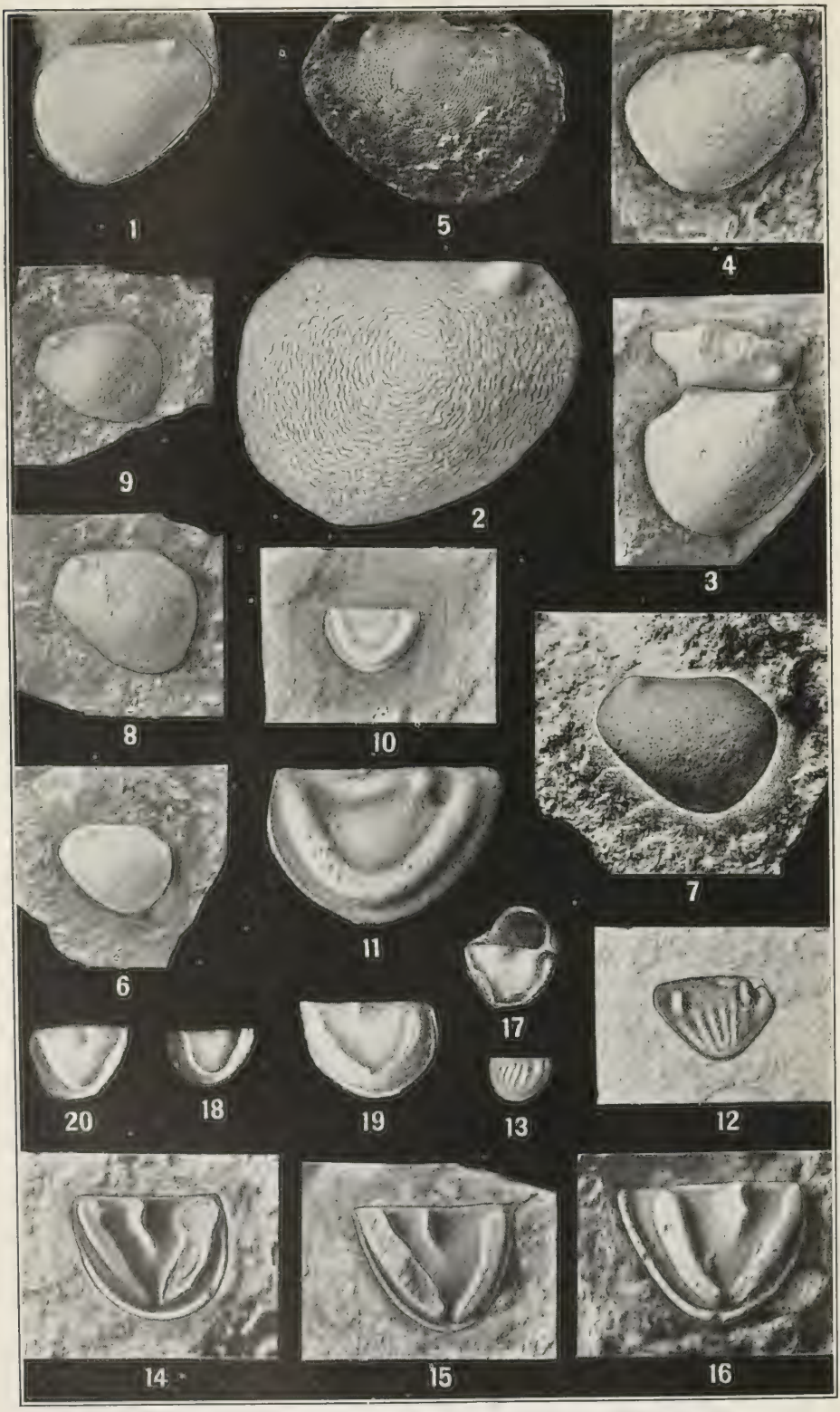
33. *Escasona vetus* Matthew, × 5 (E1*d*) 49

34. *Modiolopsis thecoides* Matthew, × 4. Lower Cambrian (Etcheminian): Newfoundland 102



CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 108.



CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 109

PLATE 2

Page

FIGURES 1–4. *Bradoria robusta* (Matthew) (see also pl. 1, figs. 1–5)------ 22
1. A well-preserved right valve, × 4.
2. Enlarged view of the same specimen, × 8, showing particularly the surface sculpture.
3. Two valves, × 4, in position.
4. A right valve, × 4, differing slightly from the usual outline.

Lower Cambrian (Etcheminian E2*a*): Dugald Brook, Nova Scotia (13*g*, 13*d*).

5. *Bradoria robusta longula*, new variety---------- 24
A left valve, × 6.
Lower Cambrian (Etcheminian E1*b*); Dugald Brook, Nova Scotia (13*t*).

6, 7. *Bradoria benepuncta* (Matthew)---------- 18
(See also pl. 1, fig. 16; pl. 3, fig. 7.)
6. A left valve, × 4.
7. Enlargement of the same, × 6.

Lower Cambrian (Etcheminian E3*d*): Dugald Brook, Nova Scotia (13*n''*).

8, 9. *Bradoria benepuncta spissa*, new variety---------- 18
8. A left valve, × 4, preserving the crowded surface punctae unusually well.
9. A smaller left valve, × 4.

Lower Cambrian (Etcheminian E2*b*): Dugald Brook, Nova Scotia (10*p*).

10, 11. *Hipponicharion confluens*, new species---------- 64
10. Photograph of the type specimen, a right valve, × 5.
11. Drawing of the same specimen, × 12, exhibiting the confluent ventral ridge.

Middle Cambrian (Johannian C2*b*1): West of Marion Bridge, Cape Breton, Nova Scotia (3*i*).

12. *Hipponicharion plicatum*, new species---------- 64
A left valve, × 5, exhibiting the subtriangular outline and the vertical folds of the surface.
Middle Cambrian: McNeil Brook, Cape Breton (3*h*).

13. *Hipponicharion parvum*, new species----------
Middle Cambrian (Johannian C2*b*): West of Marion Bridge, Cape Breton, Nova Scotia (3*i*).

14–16. *Hipponicharion minus* (Matthew) (see also pl. 7, fig. 30)-- 63
14, 15. Two left valves, × 6, exhibiting slight variations in outlines. . . .
16. A right valve, × 6.

Lower Cambrian (Hanfordian Protolenus zone, C1*b*3): Hanford Brook, New Brunswick (2*i*).

17–20. *Hipponicharion matthewi* (Wiman)---------- 63
17. Two valves of the carapace still in position, × 4.
18. A right valve of the same specimen, × 4.
19. A larger left valve, × 4.
20. A right valve, × 4 (17–20 after Wiman).

Lower Cambrian (Middle?), Glauconite sandstone: Eggegrund, Sweden.

Plate 3

Page

Figures 1, 2. *Bradoria acuta* (Matthew) (see pl. 1, fig. 25)---------- 19
1. Three specimens, × 4, of varying sizes.
2. A more robust specimen, × 4.
Lower Cambrian (Etcheminian E3*f*): Dugald Brook, Indian River, Cape Breton (13*m*).

3. *Bradoria subquadrata*, new name---------- 2
Photograph of Matthew's type A, × 5, of *Bradoria spectator acuta* Cambrian.
Lower (Etcheminian E1*d*): Dugald and Boundary Brooks, Nova Scotia.

4. *Bradoria hicksii* (Jones)---------- 31
Jones' photograph of *Leperditia hicksii*, × 4.
Cambrian: St. Davids, Wales.

5. *Bradoria medialis*, new species---------- 19
A right valve, × 4.
Lower Cambrian (Etcheminian, E2*b*): Dugald Brook, Nova Scotia (10*p*).

6. *Bradoria ovalis* (Matthew) (see also pl. 1, fig. 18)---------- 21
A left valve, × 5.
Lower Cambrian (Etcheminian, E2*b*): Dugald Brook, Nova Scotia (10*p*).

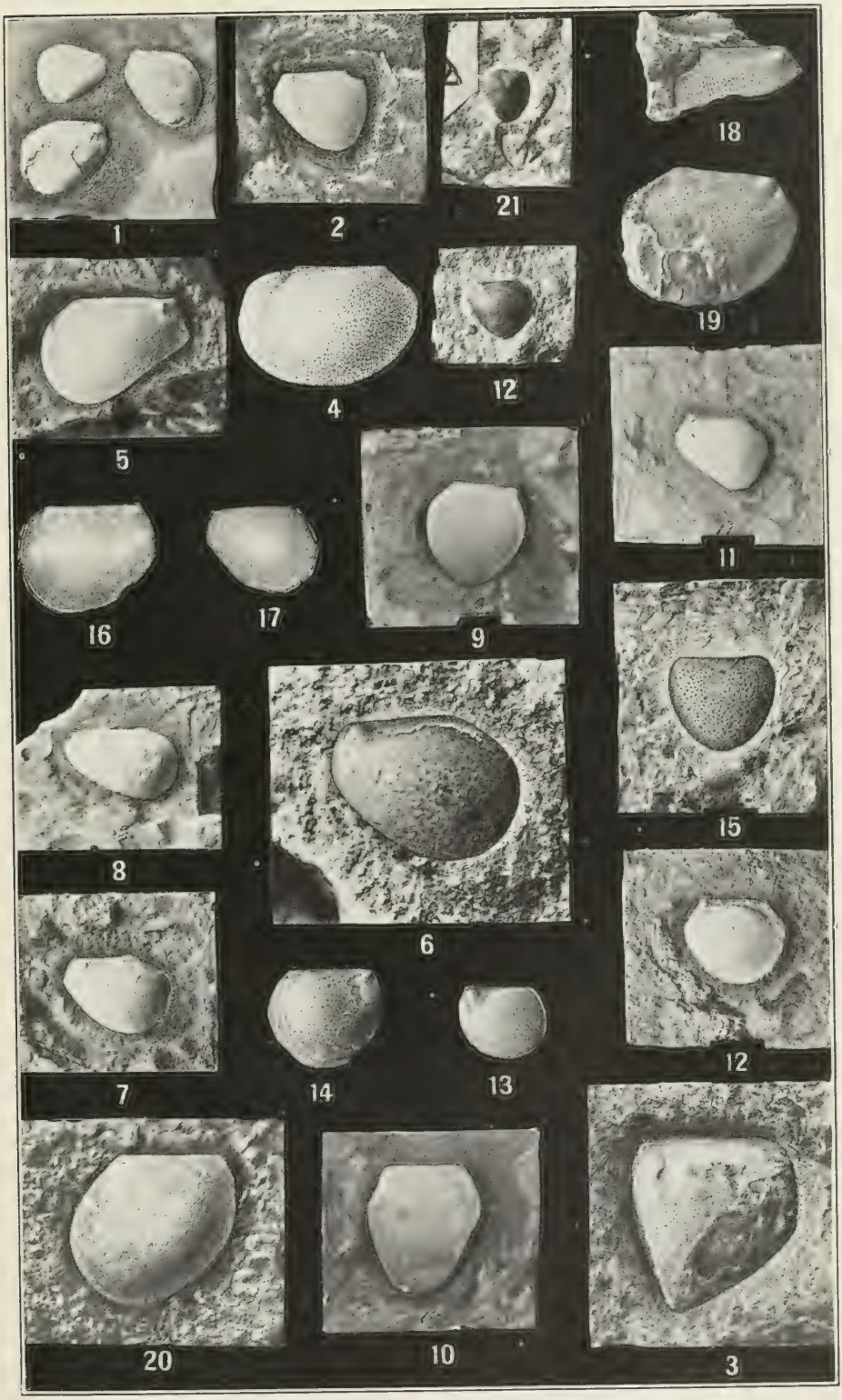
7. *Bradoria benepuncta* (Matthew) (see also pl. 1, fig. 16; pl. 2, figs. 6, 7.)---------- 18
A well preserved left valve exhibiting the normal outline, × 4.
Lower Cambrian (Etcheminian, E3*d*): Dugald Brook, Nova Scotia (13*n*″).

8. *Bradoria elongata*, new species---------- 20
A left valve, × 4.
Lower Cambrian (Etcheminian, E2*b*): Dugald Brook, Nova Scotia (10*p*).

9. *Bradoria concinna* (Matthew)---------- 28
Photograph of the type specimen, × 5, of *Schmidtella? pervetus mut. concinna* Matthew.
Lower Cambrian (Etcheminian E1*d*): Boundary Brook, Nova Scotia.

10. *Bradoria curta*, new species---------- 26
A right valve, × 5.
Lower Cambrian (Etcheminian, E3*a*): Dugald Brook, Nova Scotia (13*l*′).

11. *Bradoria scrutator* (Matthew) (see also pl. 1, figs. 11, 12)-- 14
A small left valve, × 4, showing the obscurely quadrangular outline and the far anterior location of the ocular tubercle.
Lower Cambrian (Etcheminian, E3*d*): Dugald Brook, Nova Scotia (13*n*″).



CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 110.

Page

FIGURE 12. *Bradoria perspicator* (Matthew) (see also pl. 1, figs. 6–9)---- 24
12. A left valve, × 4.
12 [1]. Matthew's type specimen A, × 2, showing aspect when unwhitened.
Lower Cambrian (Etcheminian E2*a*): Dugald Brook, N. S. (13*d*″).

13. *Bradoria obesa* (Matthew) (see also pl. 1, fig. 27)---------- 27
Photograph of the type specimen, × 5, of *Bradoria vigilans* mut. *obesa* Matthew.
Lower Cambrian (Etcheminian, E1*b*): Dugald Brook, Nova Scotia.

14, 15. *Bradoria cambrica* (Matthew) (see also pl. 1, fig. 10)----- 28
14. A right valve, × 5.
15. A left valve, × 5, differing slightly in outline from the typical form.
Lower Cambrian (Hanfordian, Protolenus zone, C1*b*3): Hanford Brook, New Brunswick (2*i*).

16. *Bradoria nitida* (Wiman)---------- 31
A right valve, × 8 (after Wiman).
Cambrian: Åland, Sweden.

17. *Bradoria fennicus* (Wiman)---------- 30
A left valve × 7 (after Wiman).
Cambrian; Åland, Sweden.

18, 19. *Bradoria vigilans concentrica*, new variety---------- 17
18. An incomplete right valve, × 4.
19. A right valve, × 4, showing particularly the more nearly vertical third of the anterior margin.
Lower Cambrian (Etc heminian, E3*d*): Dugald Brook, Nova Scotia (13*m*).

20. *Bradoria tontoensis*, new species---------- 24
The unique right valve upon which this species is founded, × 4.
Middle Cambrian: Bright Angel shale, Grand Canyon, Ariz.

21. *Beyrichona? rutellum* (Matthew) (see also pl. 1, fig. 32)-- 48
The type of *Escasona rutellum* Matthew, × 2, unwhitened, and showing the aspect of these crustacea in the rock.
Lower Cambrian (Etcheminian, E3*f*): Gillis, Indian Brook. Nova Scotia.

PLATE 4

All illustrations, × 4, and the specimens from the Bright Angel shale, Middle Cambrian, Grand Canyon, Ariz., except Figures 14–16.

Page

FIGURES 1, 2. *Walcottella apicalis*, new genus and species (genotype)---- 33

1. Left valve. The large median tubercle is imperfect and the test somewhat exfoliated, but the outline and other features characterizing the species are clearly shown. (1, Chuar Valley; 2, Bass Canyon.)
2. Broken right valve, the antero-dorsal half shown in figure almost perfectly preserved. The flattened border of this valve is more distinct on the specimen than in the photograph.

3, 4. *Walcottella concentrica*, new species---------- 34

3. A large right (?) valve, the outline somewhat imperfect on the right side. The concentric pitting of the surface is well shown.
4. A smaller, exfoliated valve, the surface markings being represented in this condition by minute interrupted concentric wrinkles. (3 Bass Canyon; 4, Chuar Valley.)

5, 6. *Walcottella breviuscula*, new species---------- 34

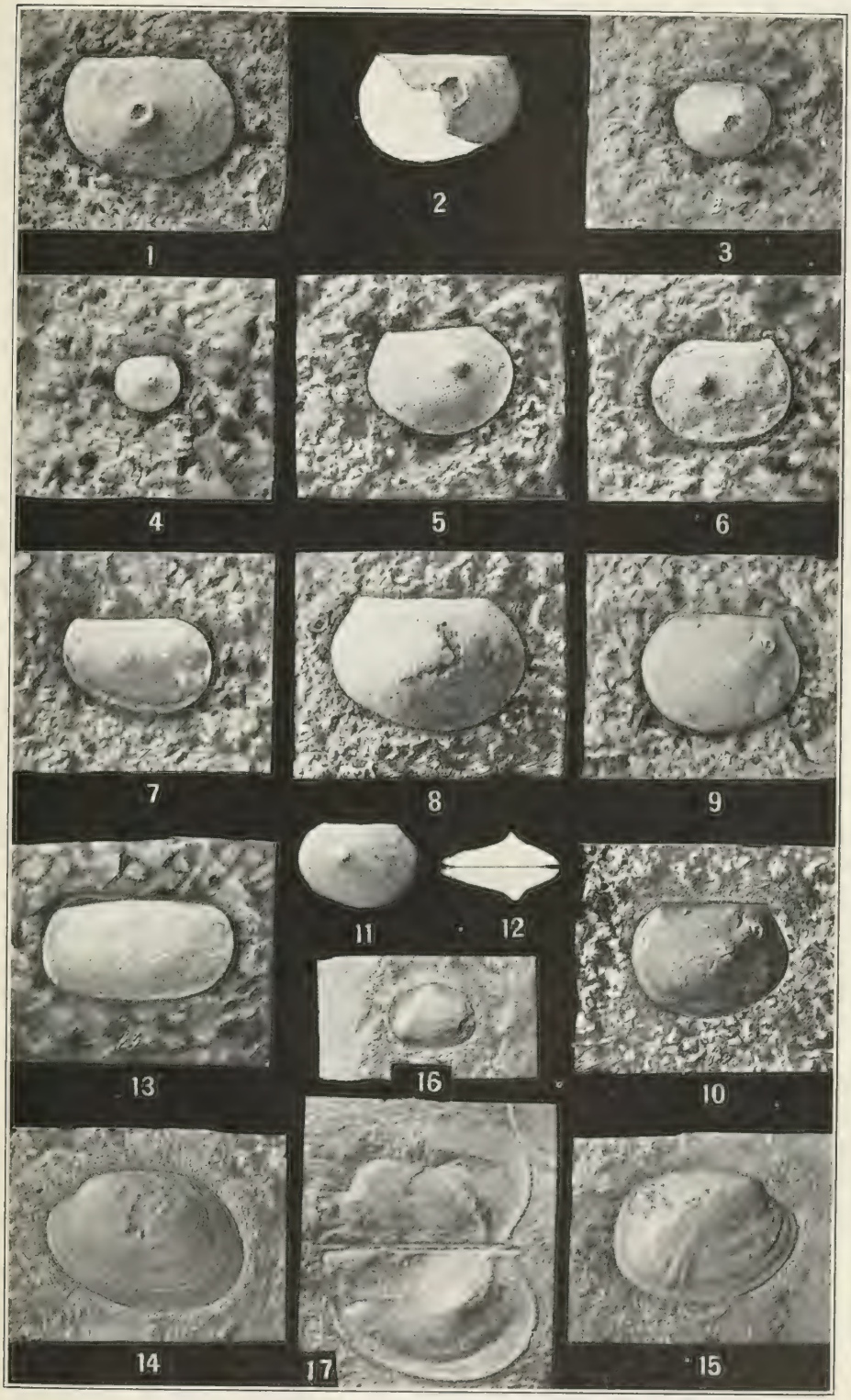
5. A left valve preserving the comparatively coarse, reticular surface ornament. According to the adopted orientation the median tubercle is behind the middle of the valve in this species.
6. Right valve, somewhat crushed, the ventral part of outline less convex than in fig. 5. (5, 6, Bass Canyon.)

7. *Walcottella scitula*, new species---------- 35

The unique specimen on which this species is founded. The ventral and posterior parts of the margin being imperfect, the supposed original form is restored in outline across the ground mass.

8. *Walcottella leperditoides*, new species---------- 37

The partially exfoliated but otherwise good left valve upon which the species is based. As usual the surface is very finely punctate or reticulate. The obsolescense of the median tubercle emphasizes the resemblance and possible relations to *Leperditia* suggested by the general form of the valve. (Bass Canyon.)



CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 112

Page

FIGURES 9, 10. *Walcottella nitida*, new species 37

9. Light print of photograph of a nearly perfect right valve.

10. Darker print of same showing surface markings and rather strong convexity of valve. The comparatively slight development of the median tubercle, the relative prominence of the ocular node, and the general shape of the valve is suggestive of the Ordovician and Silurian genus *Isochilina*. (9, 10, Bass Canyon.)

11, 12. *Walcottella pulchella*, new species 36

11. View of left side.

12. Outline in a dorsal view of a complete carapace. The valves gap at the ends and the surface is covered with minute, crowded punctae. (Bass Canyon.)

13. *Walcottella obsoleta*, new species 39

The type of this species. The specimen is thought to be a right valve. On account of the unusual abruptness of the cardinal and ventral slopes it is believed to have been originally higher, hence less elongate. The median tubercle is barely distinguishable, practically obsolete. (Bass Canyon.)

14, 15. *Fordilla troyensis* Barrande 97

14. A left valve × 6 of a well preserved carapace showing the exterior markings.

15. View of an internal cast, × 6.

Lower Cambrian: Troy, N. Y.

16. *Modioloides prisca* (Walcott) 98

The type and only specimen, × 6.

Lower Cambrian: Whitehall, Washington County, N. Y.

17. *Aluta douvillei* Mansuy 61

The best preserved specimen, × 6, on the slab figured by Mansuy.

Cambrian: Eastern Yunnan.

2607—31——8

PLATE 5

Unless otherwise stated all figures × 4, and specimens from the Middle Cambrian, Bright Angel shale of the Grand Canyon, Ariz.

Page

FIGURES 1–3. *Walcottella limatula*, new species 40

1. A right valve showing surface ornament very distinctly. The specimen is more elongate than usual, but this difference is partly accounted for by the removal of the ventral part of the flat rim.
2. Left side of a nearly perfect carapace—the holotype of the species. The specimen retains the surface ornament and shows the small "ocular node" and the larger median tubercle very satisfactorily. The anterior narrowing of the valves is characteristic of the species.
3. Ventral view of same showing anterior and posterior gaping of valves.

4–5. *Walcottella ventrosa*, new species 41

Light and dark prints of photograph of a nearly perfect right valve. This species is closely allied to *W. limatula*, but differs in its form, being relatively shorter, more rounded and produced ventrally, and narrower posteriorly.

6. *Walcottella subtruncata*, new species 41

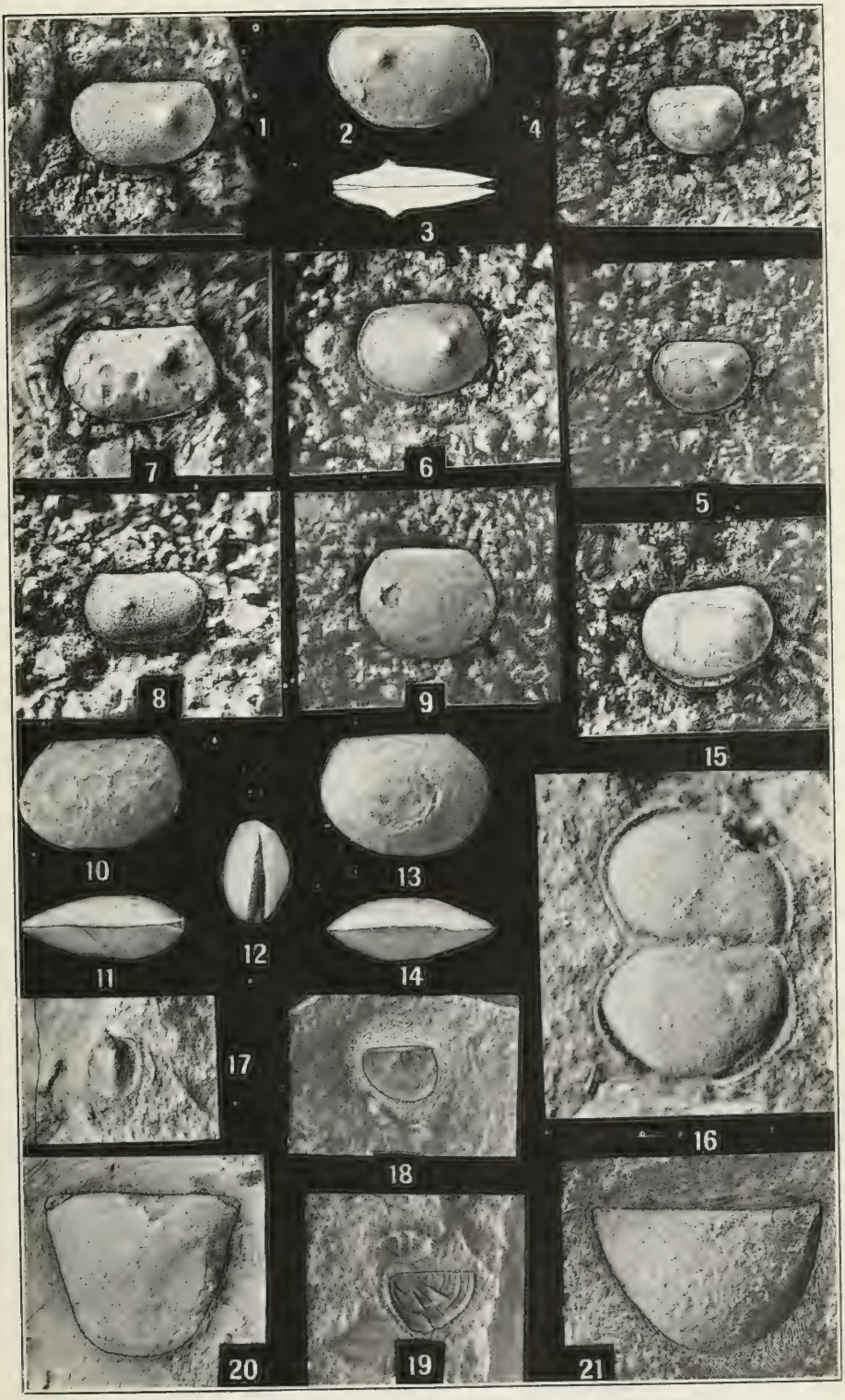
A good photograph of a right valve of this species. Except that its postdorsal part is somewhat abraded, the specimen is perfect. The truncation of the anterior side and the relatively short subovate, or subquadrate, form distinguish the species from its nearest congeners.

7. *Walcottella longula*, new species 42

A complete right valve. The photograph is not very good, being flat and lacking detail. However, it shows the features chiefly relied on in defining the species. In the shape and surface elevations of the anterior half it is much like *W. subtruncata*, but the valve on the whole is much longer and quite different in form posteriorily. Surface punctate as in Figures 1 and 6.

8. *Walcottella oblonga*, new species 38

A right valve, well preserved except along the postventral portion of the margin. As shown in the figure the general form as preserved resembles that of *W. longula*, but the medium tubercle is much less prominent and the puncto-reticulata surface ornament coarser. The original form of the specimen was probably not greatly unlike that of Figure 15 on this plate. The true affinities of *W. oblonga* are probably with *W. scitula*.



CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 114

Page

FIGURE 9. *Indiana curta*, new species ---------- 81
Left valve showing the short, broadly ovate outline chiefly relied on in distinguishing this form from *I. faba*.

10–14. *Indiana faba*, new species ---------- 79
10, 11. Views of the right and dorsal sides of a complete carapace. Valves slightly compressed so that the gap of the ends is narrower than normal.
12. Anterior views of another complete example showing gaps.
13, 14. Left and dorsal sides of a third specimen retaining both valves but compressed so as to close the gaps of the ends. The surface, when perfectly preserved, in minutely punctate.

15. *Indiana faba intermedia*, new variety ---------- 80
The right valve on which this variety is founded. From typical examples of the species it differs in postcardinal part of outline, in lesser convexity of central part of valve, and in more distant arrangement of surface punctae.

16. *Aluta* (?) *rimulata*, new species ---------- 61
A complete carapace, × 4, flattened out in the shale. Middle Cambrian (33 *m*) (Ross Lake shale): 3 mi. southwest of head of Lake Louise, Alberta.

17. *Lepidilla anomala* Matthew (see pl. 7, figs. 20–23) -------- 100
The type × 6. Middle Cambrian (Acadian, C1*c*2) Hanford Brook, New Brunswick.

18, 19. *Lepiditta curta* Matthew (see pl. 7, fig. 29) ---------- 95
Matthew's types × 6. Middle Cambrian (Acadian, C1*d*1): Porters Branch, St. Martins, New Brunswick.

20. *Lepiditta ? auriculata* Matthew (see pl. 7, fig. 26) --------- 96
The type specimen, × 6.
Middle Cambrian (Acadian, C1*c*): Hanford Brook, New Brunswick.

21. *Lepiditta ? sigillata* Matthew (see pl. 7, fig. 27) ---------- 96
Photograph of the type × 6.
Lower Cambrian (Hanfordian, C1*b*3): Hanford Brook, New Brunswick.

PLATE 6

All of the figures are × 4.

Page

FIGURES 1, 2. *Beyrichona tinea* Matthew (see also pl. 7, fig. 4)---------- 43
1. A specimen showing the two valves extended.
2. A left valve.
Lower Cambrian (Hanfordian C1*b*3): Hanford Brook, New Brunswick (2*i*).

3, 4. *Beyrichona tinea planata* (Matthew) (see also pl. 7, figs. 1–3.) 45
3. A typical or rather large right valve.
4. A right valve of the usual shape and size.
Lower Cambrian (Hanfordian C1*b*2): Hanford Brook, New Brunswick (2*h*).

5, 6. *Beyrichona tinea* Matthew var. C---------- 43
Lower Cambrian (Hanfordian C1*b*2): Hanford Brook, New Brunswick (2*h*).
Beyrichona tinea var. D.
Lower Cambrian (Hanfordian C1*b*3): Hanford Brook, New Brunswick (2*i*).

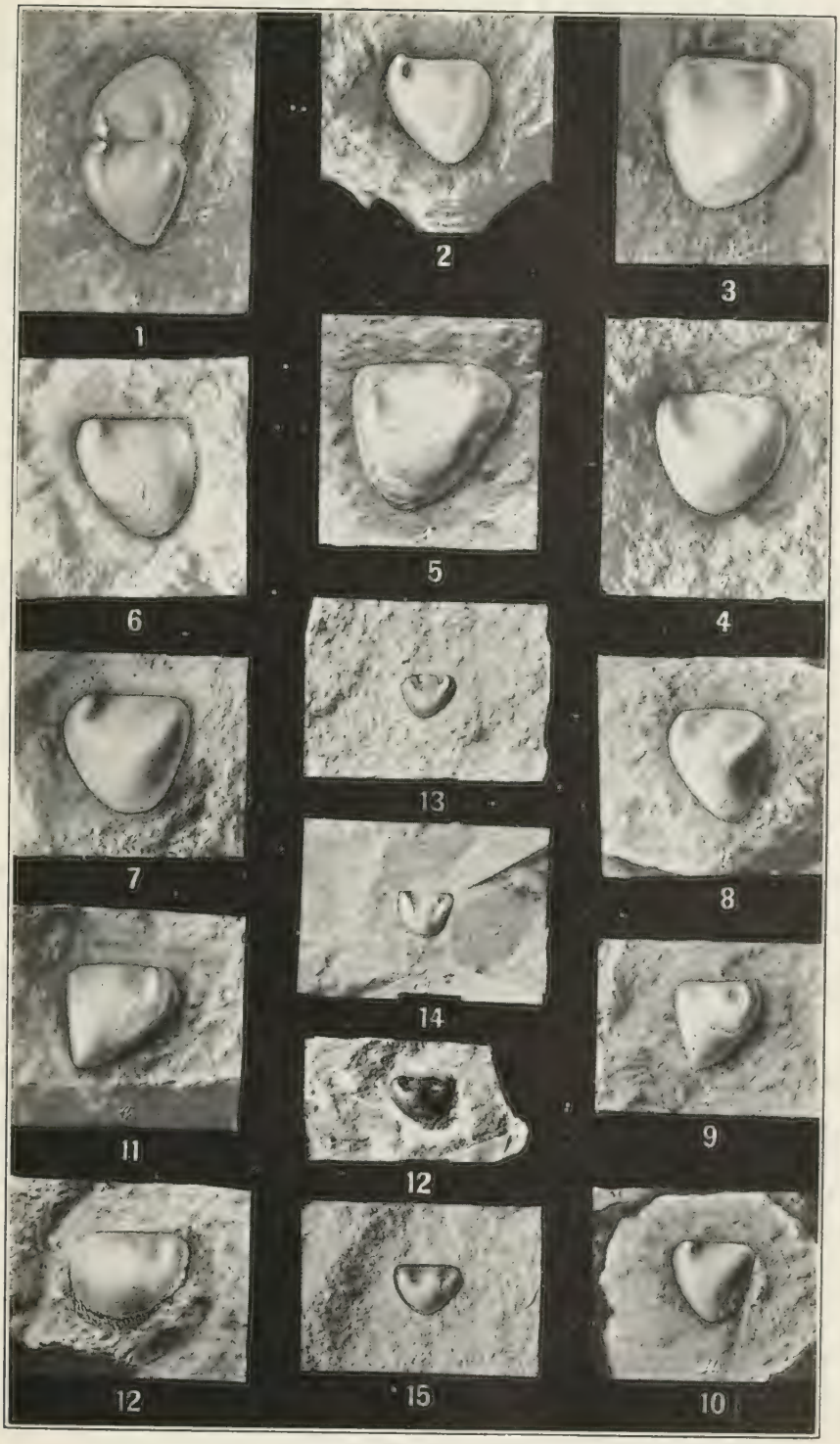
7. *Beyrichona tinea* Matthew var---------- 43
A left valve intermediate in characters between the type form and the variety *planata*.
Lower Cambrian (Hanfordian C1*b*2): Hanford Brook, New Brunswick (2*h*).

8–10. *Beyrichona tinea triangula* (Matthew)---------- 44
(See also pl. 7, figs. 8, 9.)
8. Left valve showing the usual characters of the species.
9. A smaller right valve.
10. Left valve differing slightly from the more typical form in outline.
Lower Cambrian (Hanfordian C1*b*3): Hanford Brook, New Brunswick (2*i*).

11. *Beyrichona papilio* Matthew (see also pl. 7, figs. 5–7)------- 43
A right valve.
Lower Cambrian (Hanfordian, C1*b*3): Hanford Brook, New Brunswick (2*i*).

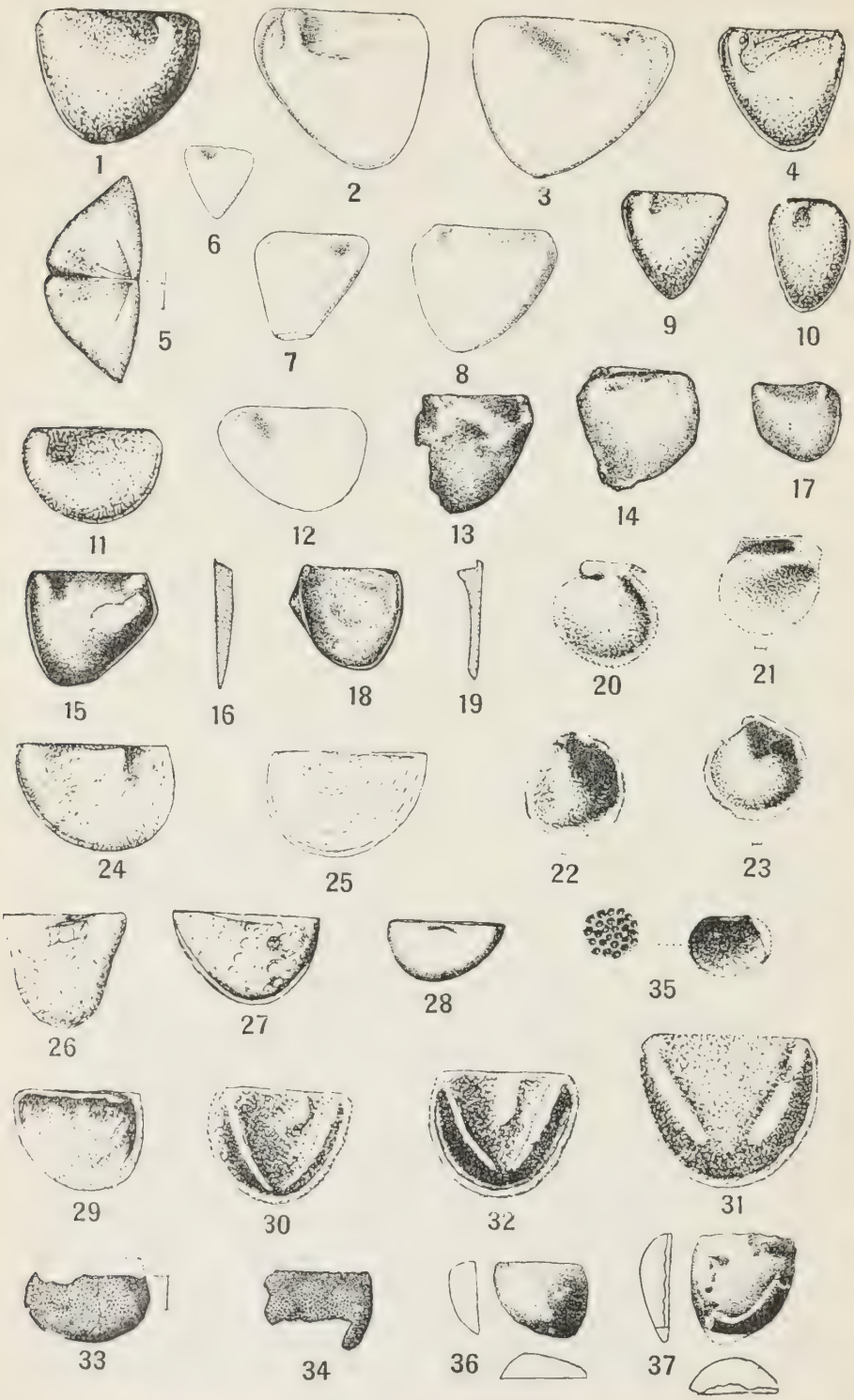
12, 12.[1] *Beyrichona rotundata* Matthew (see also pl. 7, figs. 11, 12)-- 46
12. A small but typical right valve.
12.[1] The original type, ×2, with surface unwhitened.
Lower Cambrian (Hanfordian, C1*b*2): Hanford Brook, New Brunswick (2*h*).

13–15. *Beyrichona triceps* (Matthew)---------- 46
13. A right valve with a slightly shorter hinge line than usual.
14, 15. Two right valves.
Middle Cambrian (Johannian, C2*b*): McLean Brook, Dugald Brook, and 1.5 miles west of Marion Bridge, Nova Scotia (10*s*, 3*i*, 13*g*).



CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 116.



CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 117.

PLATE 7

Figures 1, 4, 5, 9, 10, 11, 20–27, 29–32, 35, are after Matthew and Figures 13–19, after Wiman.

Page

FIGURES 1–3. *Beyrichona tinea planata* Matthew (see also pl. 6, figs. 3,4) -- 45

1. Matthew's figure of the type specimen, × 4, of *Beyrichona planata*.
2. A drawing of Matthew's type D of *Beyrichona planata* × 4.
3. Matthew's type B of *Beyrichona planata* × 4.

Lower Cambrian (Hanfordian, C1*b*2): Hanford Brook, New Brunswick.

4. *Beyrichona tinea* Matthew (see also plate 6, figs. 1, 2, 5–7) -- 43

The type specimen, a left valve, × 4.

Lower Cambrian (Hanfordian, (C1*b*2): Hanford Brook, New Brunswick.

5–7. *Beyrichona papilio* Matthew (see also pl. 6, fig. 11) ---------- 43

5. The type specimen, × 4, showing two valves in position.
6. A sketch of Matthew's type B of *Beyrichona triangula* × 4.
7. Outline drawing of Matthew's type C of *Beyrichona triangula* × 4.

Lower Cambrian (Hanfordian C1*b*3): Hanford Brook, New Brunswick.

8, 9. *Beyrichona tinea triangula* (Matthew) (see also pl. 6, figs. 8–10) ---------- 44

8. Sketch of Matthew's type A of *Beyrichona triangula* × 4.
9. Matthew's figure of this species, × 4.

Lower Cambrian (Hanfordian C1*b*3): Hanford Brook, New Brunswick.

10. *Beyrichona ovata* Matthew ---------- 47

The type specimen, × 4, showing extremely short hinge line.

Lower Cambrian (Hanfordian C1*b*2): Hanford Brook, New Brunswick.

11, 12. *Beyrichona rotundata* Matthew (see also pl. 6, fig. 12) ---------- 46

11. Matthew's view of the type specimen, × 4.
12. Drawing of the same specimen after matrix had been removed.

Lower Cambrian (Hanfordian C1*b*3): Hanford Brook, New Brunswick.

13. *Beyrichona alta Wiman* ---------- 48

An imperfect right valve, × 8.

Lower Cambrian, Olenellus sandstone: Limon near Gefle, Sweden.

Page

FIGURES 14–16. *Beyrichona gevalensis* Wiman 47
14. An imperfect valve, × 8.
15, 16. Side and edge views of a right valve, × 8.
Lower Cambrian, Olenellus sandstone: Biludden, Sweden.

17. *Beyrichona faba* Wiman 47
A left valve, × 8.
Lower Cambrian Olenellus sandstone: Limon, near Gefle, Sweden.

18, 19. *Selulla falax* Wiman 49
Side and edge views of a left valve, × 8.
Lower Cambrian, Olenellus sandstone: Biludden, Sweden.

20–23. *Lepidilla anomala* Matthew 100
Four type specimens, × 15.
Middle Cambrian (Acadian C1*c*2): Hanford Brook, New Brunswick.

24, 25. *Lepiditta alata* (Matthew) 94
24. Cast of interior of right valve, × 20.
25. Outer surface of left valve, × 20.
Middle Cambrian (Acadian C1*c*2): Hanford Brook, New Brunswick.

26. *Lepiditta ? auriculata* Matthew (see also pl. 5, fig. 20) 96
Matthew's figure of a supposed left valve of this doubtful species, × 4.
Middle Cambrian (Acadian C1*c*): Porters Brook, St. Martins, New Brunswick.

27. *Lepiditta ? sigillata* Matthew (see also pl. 5, fig. 21) 96
The greatly crushed type specimen, × 4.
Lower Cambrian (Hanfordian C1*b*3): Hanford Brook, New Brunswick.

28. *Lepiditta ? polita* (Steusloff) 95
The type specimen, a right valve (after Steusloff).
Cambrian drift; Neue Brandenburg, Germany.

29. *Lepiditta curta* Matthew (see also pl. 5, figs. 18, 19) 95
Matthew's view of the type specimen, × 10.
Middle Cambrian (Acadian, C1*d*1): Porter's Brook, St. Martins, New Brunswick.

30. *Hipponicharion minus* Matthew (see also pl. 2, figs. 14–16) 63
The type specimen, a right valve, × 6.
Lower Cambrian (Hanfordian, C1*B*3): Hanford Brook, New Brunswick.

31. *Hipponicharion eos* Matthew 62
Matthew's figure of the large valve, × 4, upon which this species is based.
Lower Cambrian (Hanfordian, C1*B*1): Hanford Brook, New Brunswick.

Page

FIGURE 32. *Hipponicharion cavatum* Matthew 63
A right valve, × 4.
Lower Cambrian (Hanfordian, C1*B*3): Hanford Brook, New Brunswick.

33, 34. *Leperditia ebenina* Dwight 101
Dwight's views of the type specimen of this species, × 2.
Middle Cambrian; Dutchess County, New York.

35. *Leperditia ventricosa* Matthew 100
View, natural size, of the imperfect type of this species and the surface ornamentation enlarged.
Lower Cambrian (Hanfordian, C1*B*1): Hanford Brook, New Brunswick.

36, 37. *Beyrichona* species.
Front and edge views of two specimens × 6 described by Cobbold as *Escasona?* species and introduced to show occurrence of *Beyrichona* types in England (after Cobbold).
Lower Cambrian (Olenellus limestone): Comley, (Shropshire), England.

PLATE 8

Page

FIGURE 1. *Aluta eris* (Walcott) ---- 53
The imperfect type specimen, a right valve, × 10 (after Walcott).
Middle Cambrian: Shensi, China.

2. *Aluta fragilis* (Walcott) ---- 57
The type, a right valve, × 6.
Middle Cambrian: Shensi, China.

3, 4. *Aluta bergeroni* (Walcott) ---- 52
3. Photograph of the type specimen, a left valve, × 5.
4. A drawing of the same specimen, × 10 (after Walcott).
Middle Cambrian: Shensi, China.

5, 6. *Aluta enyo* (Walcott) ---- 54
5. Photograph of the type specimen, a left valve, × 5.
6. Drawing of the same specimen, × 10 (after Walcott).
Middle Cambrian: Shensi, China.

7, 8. *Aluta woodi* (Walcott) ---- 56
7. Photograph of the type specimen, a left valve, × 6.
8. Drawing of the same specimen, × 10 (after Walcott).
Middle Cambrian: Shensi, China.

9, 10. *Aluta stereope* (Walcott) ---- 55
9. View of the type specimen, a right valve, × 5.
10. Drawing of the same, × 10 (after Walcott).
Middle Cambrian: Shensi, China.

11, 12. *Aluta primordialis* (Linnarsson) ---- 59
View of a left valve and cardinal edge view of the same, × 2 (after Linnarsson).
Middle Cambrian: Vestergotland, Sweden.

13, 14. *Aluta flexilis* Matthew ---- 52
13. Matthew's figure of this species, × 6.
14. Drawing of the same specimen properly oriented and with the matrix cleared away, × 4.
Middle Cambrian (Acadian, C1c1): Porter's Brook, St. Martins, New Brunswick.

15–17. *Aluta troyensis* (Ford) ---- 58
15. Sketch of Ford's type, × 3, a right valve.
Lower Cambrian: Troy. N. Y.
16. Cast of a left valve, × 2. (15, 16, after Walcott).
17. Photograph of the same specimen, × 4.
Lower Cambrian: Washington County, N. Y.

18, 19. *Aluta rotundata* (Walcott) ---- 60
18. Drawing of a right valve, × 2½ (after Walcott).
19. Photograph of a left valve. × 4.
Lower Cambrian: Washington County, N. Y.

CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 120.

Page

FIGURES 20, 21. *Entomidella? buprestis* (Salter) ---- 98
20. An example, × 215 (after Jones).
Cambrian (Menevian): St. Davids, Wales.
21. Specimen, × 3, possibly referable to this species.
Lower Cambrian (Hanfordian) *Protolenus* zone, C1*B*2: Hanford Brook, New Brunswick.

22–25. *Mononotella fusiformis* (Matthew) ---- 92
22. Matthew's figure of the type, a left valve, × 4.
23. Right side of an almost complete specimen, × 3.
24. View of the same specimen from the ventral side showing the gaping edges, × 3.
25. Cardinal side of this specimen, × 3.
Lower Cambrian (Hanfordian, C1*B*3): Hanford Brook, New Brunswick (2*i*).

26, 27. *Polyphyma lapworthi* Groom ---- 66
26. A left valve, × 14.
27. A left valve, × 10. (26, 27, after Groom).
Cambrian black shales: Southern Malverns, England.

28, 29. *Polyphyma marginata*, new species ---- 66
28. Photograph of the type specimen, an incomplete left valve, × 4.
29. Drawing of the same specimen, × 8.
Upper Cambrian: Manuel's River, Conception Bay, Newfoundland (6*u*).

30. *Polyphyma angelini* (Barrande) ---- 67
A left valve, × 4 (after Linnarsson).
Upper Cambrian: Olenus beds, Andrarum, Sweden.

31. *Polyphyma armata* (Grönwall) ---- 67
The type specimen, a right valve, × 6, of *Beyrichia angelini armata* (after Grönwall).
Middle Cambrian (Davidis zone): near Borregaard, Bornholm, Denmark.

32. *Eremos bryograptorum* (Westergaard) Moberg and Segerberg ---- 62
The original illustration introduced for comparison with *Aluta*.
Canadian (Bryograptus beds) Fogelsäng, Sweden.

33. *Aluta hollii* Jones (*Beyrichia hollii*) ---- 61
The type specimen, × 23 (after Jones).
Middle Cambrian (Menevian): St. Davids, Wales.

PLATE 9

Page

FIGURES 1–4. *Indiana lippa* Matthew 70
Various views of the type specimen, × 4.
Lower Cambrian (Etcheminian E3*f*): Dugald Brook, Nova Scotia.

5–8. *Indiana secunda* (Matthew) 71
Matthew's figures, × 4 (5) and new illustrations of the type × 3.
Lower Cambrian (Hanfordian C1*B*2): Hanford Brook, New Brunswick.

9, 10. *Indiana primaeva* Matthew 77
9. Front and side view of the type, × 4 (after Matthew).
10. Another example, × 4.
Lower Cambrian (Hanfordian C1*B*3): Hanford Brook, New Brunswick.

11, 12. *Indiana pyriformis* (Matthew) 72
11. Matthew's illustration of the type, × 4.
12. Opposite valve of another specimen, × 3.
Lower Cambrian (Hanfordian C1*B*3): Hanford Brook, New Brunswick.

13. *Indiana? acadica* Matthew 82
The type specimen, × 6 (after Matthew).
Middle Cambrian (Acadian C1*C*1): Porter's Brook, St. Martins, New Brunswick.

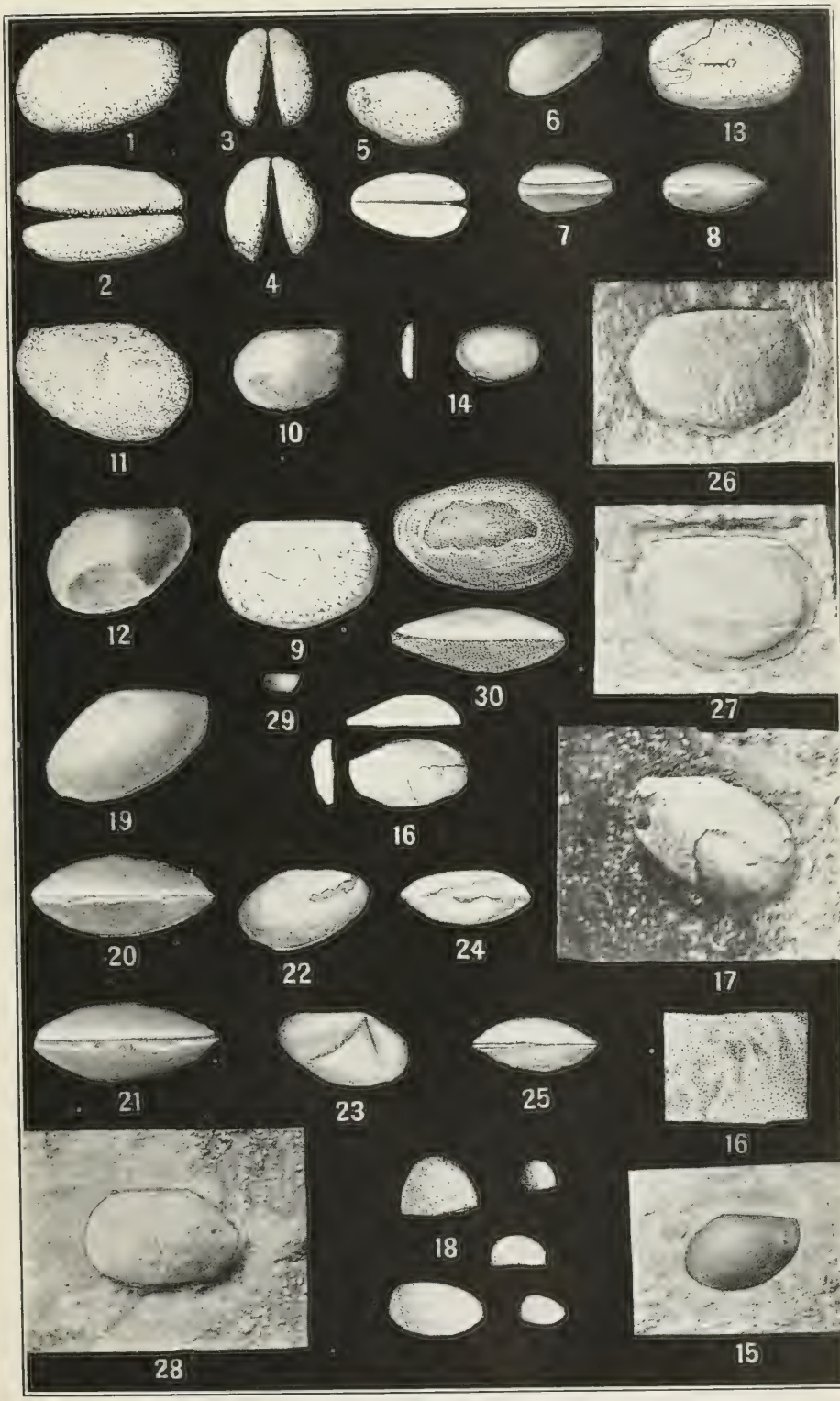
14. *Indiana? minima* Wiman 83
Front and edge views of the type, × 10, (after Wiman)
Cambrian sandstone: Åland, Sweden.

15. *Indiana matthewi*, new species 76
The type specimen, a right valve, × 3.
Middle Cambrian (Acadian, Paradoxides zone, C1*c*): Kennebecasis River, New Brunswick.

16, 17. *Indiana dermatoides* (Walcott) 75
16, 16′. The original figure of the type, × 2, with an enlargment of the surface.
17. A photograph of the same specimen, × 3.
Lower Cambrian: Washington County, N. Y.

18. *Indiana cambrensis* (Hicks) 84
A group of specimens (after Hicks).
Lower or Middle Cambrian: St. Davids, Wales.

19–21. *Indiana longula*, new species 73
Lower Cambrian (Hanfordian, C1*B*3): Hanford Brook, New Brunswick.



CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 122.

Page

FIGURES 22–25. *Indiana anderssoni* (Wiman)---------- 72
Wiman's illustrations of this species.
Lower (? Middle) Cambrian, Glauconite sandstone: Eggregrund, Sweden.

26, 27. *Indiana labiosa*, new species---------- 79
The two type specimens, × 4 representing the right and left valves.
Middle Cambrian (Stephen formation): Mount Bosworth, British Columbia.

28. *Indiana suberecta*, new species---------- 74
The type specimen × 4.
Lower Cambrian: 1½ miles north of Bald Mountain, Washington County, N. Y.

29. *Indiana* (*Leperditia*) *solvensis* (Jones)---------- 83
Cast of impression of right valve, × 2 (after Jones).
Middle Cambrian (Llandeilo flags): St. Davids, South Wales.

30. *Indiana lentiformis* Cobbold---------- 84
Side and edge views, natural size, of *Leperditia lentiformis* Cobbold (after Cobbold).
Lower Cambrian, Olenellus limestone: Comley, Shropshire, England.

Plate 10

The specimens represented in Figures 1–11 are from sandstones in the Bright Angel shale, Middle Cambrian, in the Grand Canyon, Ariz.

Page

Figure 1. *Dielymella dorsalis*, new species 89
The unique specimen, a right valve, × 4, on which this species is based. It is defective at the antero-dorsal angle and the indicated small node in this part is probably more strongly defined in the photograph than it should be.

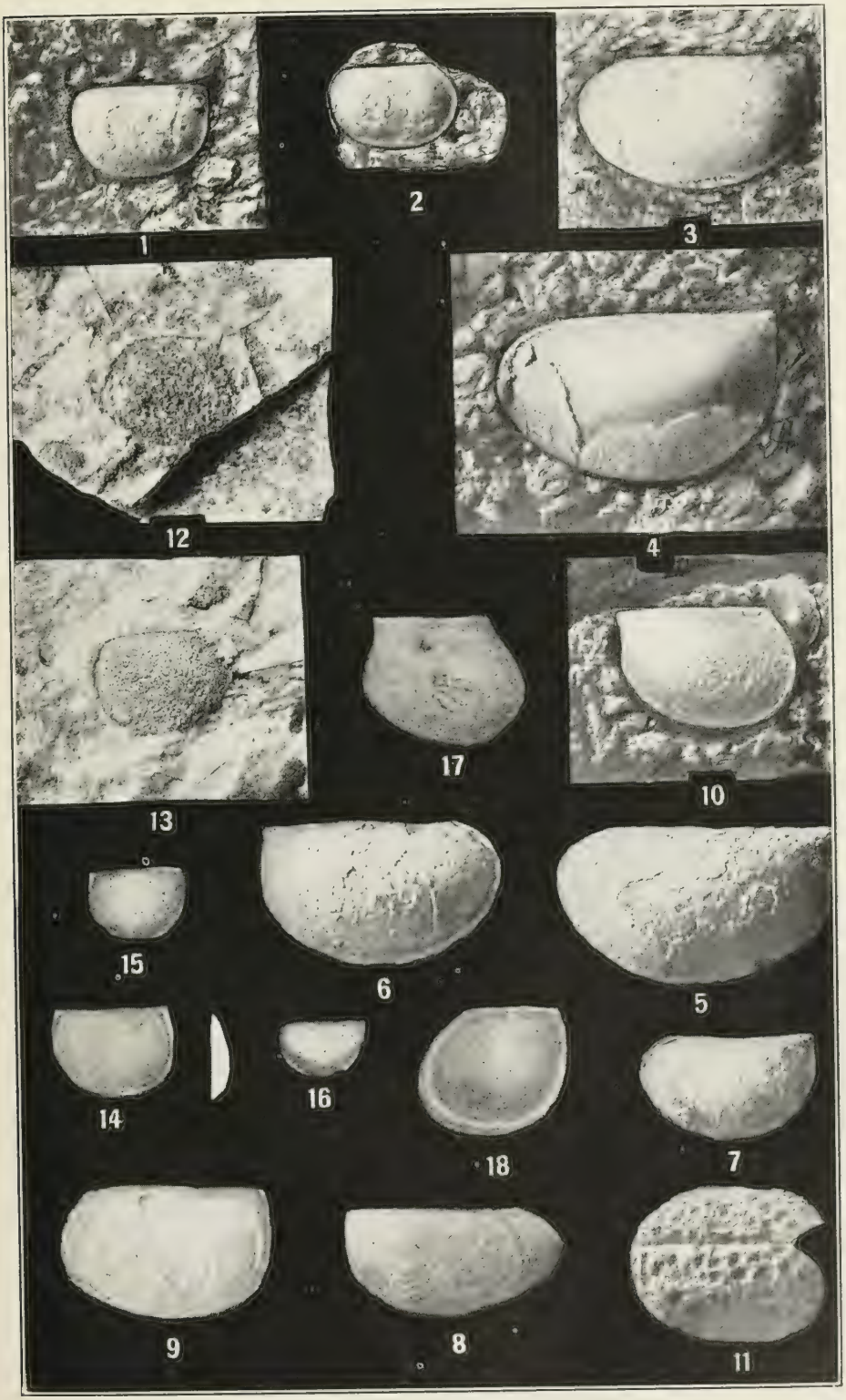
2. *Indiana impressa*, new species 81
A left valve of this species, × 4, showing the general outline and the characteristic broad median depression of the surface. In the right valve the dorsal angles are less obtuse, and this valve probably overlaps the left at these points.

3–7. *Dielymella recticardinalis*, new species 86
3. A large and typical right valve, × 3.
4. Another large right valve, × 3, varying somewhat from the average form in the greater and more uniform convexity of the antero-ventral half of the outline.
5–7. The left side of one (6) and the right sides (5 and 7) of two other entire examples, × 4. These specimens are smaller than the preceding two. In fact Figures 7, 6, 5, and 3 illustrate a progressive series in the matter of size, and prove that the variation in the specific characters of the valves is practically negligible in the later stages of growth.

8. *Dielymella recticardinalis angustata*, new variety 87
An example so much narrower than the usual form of the species that it is thought desirable to distinguish it as a distinct variety, × 4.

9. *Dielymella appressa*, new species 88
Right side of a nearly perfect cast of the interior, × 3, showing the shorter and less convex form of the carapace that distinguishes this species from *I. recticardinalis*.

10–11. *Dielymella nasuta*, new species 88
10. A good left valve, slightly imperfect along the posterior edge yet giving a fair idea of the peculiarities of the species, × 3. The prominence of the anterior extremity of the dorsal edge and the unusual width of the posterior half are the most important features.
11. A specimen retaining the two valves, × 3. In photographing it was posed so that neither valve shows the full width. The depressions in the surface are due to grains of the quartz sandstone matrix pressed into the flexible test.



CAMBRIAN CONCHOSTRACA

FOR EXPLANATION OF PLATE SEE PAGE 124

Page

FIGURES 12, 13. *Dielymella brevis*, new species ---- 89
Two examples of the large, relatively short carapace of this species, natural size.
Lower Cambrian quartzite: Sunset Hill, near Lake Dunmore, Salisbury, Vt.

14–16. "*Leperditia tatei*" Chapman ---- 102
A right valve, × 2 (14), left valve, × 5 (15), and a narrower specimen, × 2.5 (16).
Upper Cambrian limestone: Curramulka, Australia.

17. *Leperditia capsella* Chapman ---- 101
Left valve, × 5.
Upper Cambrian limestone: Curramulka, Australia.

18. "*Isochilin asweeti*" Chapman ---- 102
Right valve, × 2.5.
Upper Cambrian limestone: Curramulka, Australia
(14–18 are after Chapman, 1918.)

INDEX

[Index of genera and species. Synonyms in italics]

acadica, Indiana ... 6, 82, 122
acadica, Primitia ... 82
acuta, Bradoria ... 6, 7, 19, 108, 110
acuta, Schmidtella ... 19, 20
alata, Lepiditta ... 6, 93, 94, 118
alta, Beyrichona ... 48, 117
Aluta ... 4, 49
bergeroni ... 52, 120
douvillei ... 61, 113
enyo ... 54, 120
eris ... 53, 120
flexilis ... 6, 50, 52, 120
fragilis ... 57, 120
hollii ... 61, 121
primordialis ... 59, 120
? rimulata ... 61, 115
rotundata ... 60, 120
stereope ... 55, 120
troyensis ... 58, 120
woodi ... 56, 120
andersoni, Aparchites? ... 72
andersoni, Indiana ... 72, 123
angelini, Beyrichia ... 67
var. *armata, "Beyrichia"* ... 67
angelini, Polyphyma ... 67, 121
anomala, Lepidilla ... 6, 99, 100, 115, 118
Anomalocaris ... 5
Aparchites? andersoni ... 72
Aparchites fennicus ... 30
Aparchites? robustus ... 22, 108
secunda ... 71
apicalis, Walcottella ... 33, 112
appressa, Dielymella ... 88, 124
Aptychopsis ... 55
Apus ... 4
Aristozoe ... 49
rotundata ... 60
troyensis ... 50, 55
armata, Polyphyma ... 67, 121
auriculata, Lepiditta ... 6, 96, 115, 118
aurora, Bradoria ... 6, 30, 108
aurora, Primitia ... 30
benepuncta, Beryrichona ... 6
Bradoria ... 6, 7, 18, 108, 109, 110
spissa, Bradoria ... 7, 18, 109
bergeroni, Aluta ... 52, 120
bergeroni, Bradoria ... 52
Beyrichia angelini ... 67
"Beyrichia" angelini var. *armata* ... 67
Beyrichia hollii ... 61
(?) *primaeva* ... 29
triceps ... 46
Beyrichona ... 4, 42
alta ... 48, 117
benepuncta ... 6
Beyrichona cambrica ... 6
faba ... 47, 118
gevalensis ... 47, 118
minor ... 6
oculata ... 6
ovata ... 6, 47, 117
papilio ... 6, 43, 116, 117
Beyrichona planata ... 45
Beyrichona rotundata ... 6, 46, 116, 117
rutellum ... 6, 48, 111
species ... 119
tinea ... 6, 43, 116, 117
planata ... 6, 45, 116, 117
triangula ... 6, 44, 116, 117
Beyrichona triangula ... 43, 44
Beyrichona triceps ... 6, 46, 116
Beyrichonidae ... 42
Bidentia ... 4
Bradoria ... 4, 12, 49
acuta ... 6, 7, 19, 108, 110
(?) aurora ... 6, 30, 108
benepuncta ... 6, 7, 18, 108, 109, 110
spissa ... 7, 18, 109
Bradoria bergeroni ... 52
Bradoria cambrica ... 28, 103, 111
concinna ... 7, 28, 110
curta ... 7, 26, 110
Bradoria douvillei ... 61
Bradoria elongata ... 6, 7, 20, 110
Bradoria enyo ... 54
eris ... 53
Bradoria fennicus ... 30, 111
Bradoria fragilis ... 57
Bradoria hicksii ... 31, 110
medialis ... 7, 19, 110
minor ... 29, 108
nitida ... 31, 111
obesa ... 6, 7, 27, 108, 111
Bradoria observator mut *laevis* ... 21
ligata ... 19
Bradoria oculata ... 16, 108
ornata ... 7, 30, 108
ovalis ... 6, 7, 21, 108, 110
prima ... 7
perspicator ... 7, 24, 108, 111
primaeva ... 6, 29, 108
robusta ... 6, 7, 22, 108, 109
longula ... 7, 24, 109
rugulosa ... 6, 7, 21, 108
scrutator ... 6, 12, 14, 108, 110
Bradoria scrutator ... 18
Bradoria spectator ... 6, 7, 25, 108
spinosa ... 6, 7, 26, 108
(?) steadi ... 6, 29, 108
Bradoria stereope ... 55

	Page
Bradoria subquadrata	7, 20, 110
tontoensis	24, 111
Bradoria vigilans	6, 7, 16, 108
concentrica	6, 17, 111
Bradoria vigilans	17, 27
mut *obesa*	27
woodi	56
Bradorona	4, 12
nitida	31
observator	25
benepuncta	18
ligata	15
perspicator	24
magna	22, 108
major	22, 108
maxima	22, 108
spectator	25
acuta	19, 20
aequata	26, 108
spinosa	26
brevis, Dielymella	89, 125
breviuscula, Walcottella	34, 112
bryograptorum, Eremos	61, 62, 121
buprestis, Entomidella	6, 98, 121
buprestis, Entomis	98
Leperditia	98
Burgessia	4
Bythocypris polita	95
cambrensis, Indiana?	84, 122
cambrensis, Leperditia	84
cambrica, Beyrichona	6
Bradoria	28, 108, 111
cambrica, Schmidtella	28
capsella, "Leperditia"	101, 125
Carnarvonia	5
Caryocaris	5
cavatum, Hipponicharion	6, 63, 119
Ceratiocaris	5
concentrica, Walcottella	34, 112
concinna, Bradoria	7, 28, 110
confluens, Hipponicharion	6, 64, 109
curta, Bradoria	7, 26, 110
Indiana	81, 115
Lepiditta	95, 115, 118
dermatoides, Indiana	6, 75, 122
dermatoides, Leperditia	75
Dielymella	5, 85
appressa	88, 124
brevis	89, 125
dorsalis	89, 124
nasuta	88, 124
recticardinalis	86, 124
angustata	87, 124
dorsalis, Dielymella	89, 124
douvillei, Aluta	61, 113
douvillei, Bradoria	61
ebenina, "Leperditia"	101, 119
elongata, Bradoria	6, 7, 20, 110
Entomidella? buprestis	6, 98, 121
Entomis buprestis	98
enyo, Aluta	54, 120
enyo, Bradoria	54
Eopteria	4
eos, Hipponicharion	6, 62, 118
Eremos	4, 61
bryograptorum	61, 62, 121

	Page
eris, Aluta	53, 120
eris, Bradoria	53
Escasona	4, 42
Escasona ingens	7, 48, 108
Escasona ovata	47
rutellum	42, 48, 108
Escasona vetus	49, 105
Estheria	5
Estheriella	4
Euchasma	8
faba, Beyrichona	47, 118
Indiana	79, 115
intermedia, Indiana	80, 115
fallax, Sellula	49, 118
fennicus, Aparchites	30
fennicus, Bradoria	30, 111
Fieldia	5
flexilis, Aluta	6, 50, 52, 120
Fordilla	5, 97
troyensis	96, 113
fragilis, Aluta	57, 120
fragilis, Bradoria	57
fusiformis, Indiana	92
fusiformis, Mononotella	6, 92, 121
fusiformis, Primitia?	92
gevalensis, Beyrichona	47, 118
hicksii, Bradoria	31, 110
hicksii, Leperditia	31
Hipponicharion	4, 62
cavatum	6, 63, 119
confluens	6, 64, 109
eos	6, 62, 118
matthewi	63, 109
minus	6, 63, 109, 118
parvum	6, 64, 109
plicatum	6, 64, 109
hollii, Aluta	61, 121
hollii, Beyrichia	61
Hurdia	5
Hymenocaris	5
impressa, Indiana	81, 124
Indiana	12
Indiana	5, 68
? acadica	6, 82, 122
andersoni	72, 123
? cambrensis	84, 122
curta	81, 115
dermatoides	6, 75, 122
faba	79, 115
intermedia	80, 115
Indiana fusiformis	92
Indiana impressa	81, 124
labiosa	79, 123
lentiformis	84, 123
Indiana lippa	6, 68, 70, 122
longula	6, 73, 122
matthewi	5, 76, 122
? minima	83, 122
Indiana ovalis	21
mut *prima*	21, 108
Indiana primaeva	6, 77, 122
pyriformis	6, 72, 122
Indiana? robusta	22
Indiana secunda	6, 71, 122
? solvensis	83, 123
suberecta	74, 123

	Page
Indianidae	68
ingens, Escasona	7, 48, 108
Ischyrina	4
"Isochilina" sweeti	102, 125
Isochilina ventricosa	100
Isoxys	4
labiosa, Indiana	79, 123
lapworthi, Polyphyma	65, 66, 121
larval trilobite	102
Leancholia	4
Leia	5
lentiformis, Indiana	84, 123
lentiformis, Leperditia?	84
Leperditia	12, 49
buprestis	98
cambrensis	84
"Leperditia" capsella	101, 125
Leperditia dermatoides	75
"Leperditia" ebenina	101, 119
Leperditia hicksii	31
? lentiformis	84
? minor	29
? primaeva	77
primordialis	59
(Isochilina) primordialis	59
punctatissima	98
?? rugosa	22, 108
"Leperditia" solitara	102
Leperditia solvensis	83
steadi	29
"Leperditia" tatei	101, 125
Leperditia troyensis	58
Leperditia ventricosa	6, 100, 119
vexata	102
leperditoides, Walcottella	37, 112
Lepidilla	5, 99
anomala	6, 99, 100, 115, 118
Lepiditta	5, 93
alata	6, 93, 94, 118
auriculata	6, 96, 115, 118
curta	95, 115, 118
? polita	95, 118
sigillata	9, 96, 115, 118
Lepidurus	4
limatula, Walcottella	40, 114
lippa, Indiana	6, 68, 70, 122
longula, Indiana	6, 73, 122
Walcottella	42, 114
marginata, Polyphyma	66, 121
matthewi, Hipponicharion	63, 109
Indiana	6, 76, 122
medialis, Bradoria	7, 19, 110
minima, Indiana?	83, 122
minor, Beyrichona	6
Bradoria	29, 108
minor, Leperditia (?)	29
minus, Hipponicharion	6, 63, 109, 118
Modioloides	5, 98
prisca	98, 113
Modiolopsis? prisca	98
Modiolopsis thecoides	102, 108
Mononotella	5, 91
fusiformis	6, 92, 121
nasuta, Dielymella	88, 124
nitida, Bradoria	31, 111
nitida, Bradorona	31
nitida, Walcottella	37, 113
Nothozoe? vermontana	89
obesa, Bradoria	6, 7, 26, 108, 111
oblonga, Walcottella	37, 114
observator, Bradorona	25
benepuncta, Bradorona	18
laevis, Bradoria	21
ligita, Bradorona	15, 19
obsoleta, Walcottella	37, 113
oculata, Beyrichona	6
Bradoria	16, 108
oculata, Primitia	16
Odaraia	5
Opabinia	4
ornata, Bradoria	7, 30, 108
ovalis, Bradoria	6, 7, 21, 108, 111
prima, Bradoria	7
ovalis, Indiana	21, 108
prima, Indiana	21
ovata, Beyrichona	6, 47, 117
ovata, Escasona	47
papilio, Beyrichona	6, 43, 161, 117
parvum, Hipponicharion	6, 64, 109
perspicator, Bradoria	7, 24, 108, 111
perspicator, Bradorona	24
magna, Bradorona	22, 108
major, Bradorona	22, 108
maxima, Bradorona	22, 108
pervetus, Schmidtella	6, 27, 108
pervetus mut *concinna, Schmidtella?*	28
planata, Beyrichona	45
plicatum, Hipponicharion	6, 64, 109
polita, Bythocypris	95
polita, Lepiditta?	95, 118
Polyphyma	4, 64
angelini	67, 121
armata	67, 121
lapworthi	65, 66, 121
marginata	66, 121
primaeva, Beyrichia?	29
primaeva, Bradoria	6, 29, 108
Indiana	6, 77, 122
primaeva, Leperditia?	77
Primitia acadica	82
aurora	30
(?) fusiformis	92
oculata	16
pyriformis	72
Primitia simplex lloydiana	103
milneana	103
sanctojohannesiana	103
Primitia solvensis	83
primordialis, Aluta	59, 120
primordialis, Leperditia	59
prisca, Modioloides	98, 113
prisca, Modiolopsis?	98
Protocaris	4
pulchella, Walcottella	34, 113
punctatissima, Leperditia	98
pyriformis, Indiana	6, 72, 122
pyriformis, Primitia	72
recticardinalis, Dielymella	86, 124
angustata, Dielymella	87, 124
Ribeira	4
Ribeiriella	4
rimulata, Aluta?	61, 115

Page

robusta, Bradoria 6, 7, 22, 108
longula, Bradoria 7, 24, 109
robusta, Indiana? 22
robustus, Aparchites? 22, 108
rotundata, Aluta 60, 120
rotundata, Aristozoe 60
rotundata, Beyrichona 6, 46, 116, 117
rugosa, Leperditia?? 22, 108
rugulosa, Bradoria 6, 7, 21, 108
rutellum, Beyrichona 6, 48, 11
rutellum, Escasona 42, 48, 108
Schizodiscus 5
Schmidtella 12
acuta 19, 20
cambrica 28
Schmidtella pervetus 6, 27, 108
Schmidtella? pervetus mut *concinna* 28
scitula, Walcottella 34, 112
scrutator, Bradoria 6, 12, 14, 108, 110
scrutator, Bradoria 18
secunda, Aparchites 71
secunda, Indiana 6, 71, 122
Sellula 4, 49
fallax 49, 118
Shafferia 5
sigillata, Lepiditta 6, 96, 115, 118
simplex lloydiana, Primitia 103
milneana, Primitia 103
sanctojohannesiana, Primitia 103
solitaria, "Leperditia" 102
solvensis, Indiana? 83, 123
solvensis, Leperditia 83
Primitia 83
spectator, Bradoria 6, 7, 25, 108
spinosa, Bradoria 6, 7, 26, 108
spectator, Bradorona 25
acuta, Bradorona 19, 20
aequata, Bradorona 26, 108
spinosa, Bradorona 26
steadi, Bradoria 29, 108
steadi, Leperditia 29
stereope, Aluta 55, 120
stereope, Bradoria 55
suberecta, Indiana 74, 123
subquadrata, Bradoria 7, 20, 110

Page

subtruncata, Walcottella 41, 114
sweeti, "Isochilina" 102, 125
tatei, "Leperditia" 101, 125
Technophorus 4
thecoides, Modiolopsis 102, 108
tinea, Beyrichona 6, 43, 116, 117
planata, Beyrichona 6, 45, 116, 117
triangula, Beyrichona 6, 44, 116, 117
tontoensis, Bradoria 24, 111
triangula, Beyrichona 43, 44
triceps, Beyrichia 46
triceps, Beyrichona 6, 46, 116
troyensis, Aluta 58, 120
troyensis, Aristozoe 50, 55
troyensis, Fordilla 96, 113
troyensis, Leperditia 58
Tuzoia 5
ventricosa, Isochilina 100
ventricosa, Leperditia 6, 100, 119
ventrosa, Walcottella 41, 114
vermontana, Nothozoe? 89
vetus, Escasona 48, 108
vexata, "Leperditia" 102
vigilans, Bradoria 17, 27
vigilans, Bradoria 6, 7, 16, 108
concentrica, Bradoria 6, 17, 111
vigilans obesa?, Bradoria 27
Walcottella 4, 12, 31
apicalis 33, 112
breviuscula 34, 112
concentrica 34, 112
leperditoides 37, 112
limatula 40, 114
longula 42, 114
nitida 37, 113
oblonga 38, 114
obsoleta 39, 113
pulchella 36, 113
scitula 35, 112
subtruncata 41, 114
ventrosa 41, 114
Waptia 5
woodi, Aluta 56, 120
woodi, Bradoria 56
Yohoia 7

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NEW AND OLD LAND SHELLS FROM THE ISLAND OF LUZON, PHILIPPINES

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Several small sendings of land mollusks from the island of Luzon transmitted to the United States National Museum for determination by the Philippine Bureau of Science, have necessitated a revision of certain species of *Cochlostyla*, the results of which are given in the following pages. There are also added descriptions of a new species of *Leptopoma* and a new subspecies of *Obba* and *Sulfurina*, which were included in the same sending.

The illustrations accompanying this paper are from photographs made by the Division of Photography, United States National Museum, and retouched by Mrs. Aime M. Awl.

COCHLOSTYLA DUBIOSA Pfeiffer

In the genus *Cochlostyla*, there is probably no species which to-day presents a greater confusion of elements in collections than exists in the complex which is usually designated under the foregoing name. This has been largely caused by the fact that the collectors of old were not cognizant of the important rôle of what is to-day called Zoogeographic distribution. Then it was not known that most species or their races have a rather limited locus. The early collector therefore usually placed specimens of more or less superficial resemblance together and a label "Philippine Islands," seemed quite adequate to denote their country. Cuming, the most prolific of the early Philippine collectors, did somewhat better, as a rule, by citing the island from which his specimens came.

The describers of species, working upon Cuming's collections, cautiously gave a wide distribution to many of the forms described by them. Many of the forms cited as coming from islands other than those from which the type came, have since been recognized as distinct species or subspecies by later writers.

Pfeiffer in describing *Helix dubiosa* in 1845 in the Proceedings of the Zoological Society of London (pp. 125–6) says: "This is the

shell figured by Mr. Reeve under the name *H. decipiens*, Sowerby [1] and this figure quite well represents what I consider *Cochlostyla dubiosa*. It was more than likely based upon one of Cuming's shells from the island of Samar. Pfeiffer also says that his species was "Collected by Mr. Cuming on the island of Samar."

A year later Pfeiffer redescribes and figures *Helix dubiosa* in the Conchylien Cabinet of Martini and Chemnitz (p. 281, pl. 46, figs. 5 and 6). The description is a copy of his former definition, but the figure represents one of the races of what I am here calling *Cochlostyla submirabilis* Möllendorff. This was the beginning of the confusion that has since prevailed.

Cochlostyla dubiosa Pfeiffer closely resembles *Cochlostyla submirabilis* both in shape and color markings. Both may or may not have a dark umbilical area and one to three brown spiral zones. In all our *Cochlostyla dubiosa* the brown zones are never peripheral but, when present, sub or supraperipheral, always leave a light zone at the periphery. In *Cochlostyla submirabilis* on the other hand, if a dark zone is present on or near the middle of the whorl it always occupies the peripheral area. Both species have hydrophanous spiral lines or bands of varying width. The most significant distinguishing character however is the presence of very regular closely spaced strongly incised spiral lines in *Cochlostyla dubiosa*. These lines are present both on the areas occupied by the hydrophanous bands and the spaces between them, on spire and base. In *Cochlostyla submirabilis* Möllendorff incised spiral lines, if present at all, are merely indicated and never regularly developed, nor do they cover the entire surface of the shell. This species also has a tendency to be provided with crisscross scratchy lines.

Two other species with which some races of both of these species have been confused are *Cochlostyla mirabilis* Ferussac and *Cochlostyla persimilis* Ferussac. The races of these while in some instances approximating *Cochlostyla submirabilis* Möllendorff can be easily distinguished from them by the absence of the hydrophanous spiral zones. In *Cochlostyla mirabilis* there is scarcely any periostracum, the shells usually being of white ground color. In *Cochlostyla persimilis*, on the other hand, there is always a strongly developed straw-colored, pale orange or brownish orange periostracum present.

Cochlostyla speciosa Jay has been referred to *C. dubiosa* by some authors. Through the kindness of the American Museum of Natural History I have been able to examine the two fine specimens upon which Jay based his name. They do not belong here but are allied to *Cochlostyla coccomelos* Sowerby.

[1] Conchologia Systematica, vol. 2, pl. 145, fig. 16.

A KEY TO DIFFERENTIATE SPECIES OF COCHLOSTYLA

Hydrophanous lines and bands present.
Strongly incised spiral lines present on spire and base.....dubiosa.
Strongly incised spiral lines absent on spire and base.....submirabilis.
Hydrophanous lines and bands absent.
Periostracum strongly developed.....persimilis.
Periostracum almost absent.....mirabilis.

Of *Cochlostyla dubiosa* Pfeiffer three races, which I shall recognize subspecifically, are in the collection of the United States National Museum. The typical race comes from the island of Samar, another from the small island of Capul off the northwest coast of Samar, which I shall call *Cochlostyla dubiosa capulensis*, and the third *Cochlostyla dubiosa volubilis* Reeve from the island Batan, of the Batanes Group, the northernmost of the Philippine Islands.

This discontinuous distribution, presented by the last mentioned race, has puzzled all the writers who have given serious thought to the problem. Von Möllendorff has suggested introduction with plants. This seems not unlikely since Batan Island was given considerable prominence during Spanish occupation. The fact that the other islands of the Batanes Group have not yielded the same or allied races adds additional color to this contention. The Batan shells differ sufficiently from those of Samar and Capul to deserve a name. It would be interesting to know from where they came originally, in order to determine whether the characters which they present are still the same as those of the ancestral stock or whether they are the responses to the more northern environmental conditions.

The following brief description and figures should help to recognize these races:

COCHLOSTYLA DUBIOSA DUBIOSA Pfeiffer

Plate 1, Figures 1–4.

1842. *Helix decipiens* Reeve, Conch. syst., vol. 2, pl. 165, fig. 16 (not pl. 163, fig. 3).
1842. *Helix dubiosa* Pfeiffer, Symbolae II, p. 71.
1845. *Helix dubiosa* Pfeiffer, Proc. Zool. Soc. London, pp. 123–4.
1846. *Helix dubiosa* Pfeiffer, Martini-Chemnitz, Conch. Cab., ed. 2, vol 1, part 12, p. 281 in part, exclusive of figures.
1848. *Helix dubiosa* Pfeiffer, Monogr. Helic. vivent., vol. 1, p. 252 in part.
1850. *Helix dubiosa* Albers, Heliceen, ed. 1, p. 105.
1851. *Helix dubiosa* Reeve, Conch. Icon., pl. 5, fig. 22.
1853. *Helix dubiosa* Pfeiffer, Mon. Helic. vivent., vol. 3, p. 188, in part.
1853. *Helix dubiosa* Pfeiffer, Mon. Helic. vivent., vol. 3, p. 172, in part.
1858. *Helix dubiosa* H. and A. Adams, Gen. Rec. Mol., vol. 2, p. 192.
1859. *Helix dubiosa* Pfeiffer, Mon. Helic. vivent., vol. 4, p. 210, in part.

1860. *Helix dubiosa* MARTENS, Albers, Heliceen, ed. 2, p. 172.
1868. *Helix dubiosa* PFEIFFER, Mon. Helic. vivent., vol. 5, p. 283, in part.
1870. *Cochlostyla dubiosa* SEMPER, Philippinen, pt. 2, vol. 3, p. 180, in part.
1870. *Cochlostyla mirabilis* SEMPER, Philippinen, pt. 2, vol. 3, p. 192.
1876. *Cochlostyla dubiosa* PFEIFFER, Mon. Helic. vivent., vol. 7, in part, p. 324.
1881. *Cochlostyla dubiosa* PFEIFFER, Clessin Nomenclator, p. 203.
1887. *Cochlostyla dubiosa* HIDALGO, Journ. Conchyl., vol. 35, p. 145, in part.
1891. *Cochlostyla dubiosa* PILSBRY, Man. Conch., ser. 2, vol. 7, pp. 135–6, in part, pl. 32, fig. 52.
1896. *Cochlostyla dubiosa* HIDALGO, Journ. Conchyl., vol. 44, pp. 5–8, in part.
1897. *Cochlostyla mirabilis* MÖLLENDORFF, Nachr. Deut. Malak. Ges., vol. 29, pp. 127–9, in part.
1898. *Cochlostyla mirabilis* MÖLLENDORFF, Abhand. Naturf. Ges. Görlitz, vol. 22, p. 113.
1901. *Cochlostyla dubiosa* HIDALGO, Obras, Malac., p. 303–6, in part.
1907. *Cochlostyla mirabilis* MÖLLENDORFF. Kobelt and Winter, Semper. Reis. Arch. Philip., vol. 10, pt. 7, pp. 148–9, in part, pl. 30, fig. 1?.

In the collection of the United States National Museum are two shells, Cat. No. 104053, U.S.N.M., from Samar which have the light peripheral zone bordered above and below by a broad band of chestnut brown. There is also a faint band of brown present at the summit. One of these shells has a brown umbilical area, while in the other there is scarcely an indication of a darker coloration present in this area. The rest of the last whorl is horn colored with indications of hydrophanous bands. Both of our shells are considerably weathered, therefore the poor showing of the hydrophanous marking. The early turns are flesh colored excepting a narrow zone of brown at the summit and the suture. The peristome is broadly expanded and reflected and white. The interior of the aperture is pearly white except where the dark spiral zones show through the substance of the shell. The incised spiral lines are rougher than in the other two races, in fact the shells have a coarser appearance in every way. These shells have 4.5 and 4.3 whorls, respectively, and measure—height, 32.2 and 27.6 mm.; greater diameter, 34.3 and 32.4 mm.; lesser diameter, 29.3 and 26.8 mm.

COCHLOSTYLA DUBIOSA VOLUBILIS Reeve

Plate 1, Figures 9–12

1851. *Helix batanica* REEVE, Conch. Icon., pl. 9, fig. 2 (not *Helix batanica* Adams and Reeve 1847 of Voyage of the Samarang).
1851. *Helix volubilis* REEVE, Conch. Icon., see errata.
1853. *Helix dubiosa* PFEIFFER, Mon. Helic. vivent., vol. 3, p. 188, in part.
1859. *Helix dubiosa* PFEIFFER, Mon. Helic. vivent., vol. 4, p. 210, in part.
1876. *Helix decipiens* PFEIFFER, Mon. Helic. vivent., vol. 7, p. 324, in part.
1881. *Helix dubiosa* PFEIFFER, Clessin Nomenclator, p. 203, in part.

1887. *Cochlostyla batanica* HIDALGO, Journ. Conchyl., vol. 35, p. 145, in part.
1890. *Cochlostyla dubiosa* PILSBRY, Man. Conch., ser. 2, vol. 7, pp. 135–6, in part, pl. 32, fig. 53.
1894. *Cochlostyla dubiosa* PILSBRY, Man. Conch., ser. 2, vol. 9, p. 222.
1896. *Cochlostyla batanica* HILDALGO, Journ. Conchyl., vol. 44, pp. 6–7, in part.
1896. *Cochlostyla speciosa* HILDALGO, Journ. Conchyl., vol. 44, pp. 8–9, in part.
1897. *Cochlostyla batanica* MÖLLENDORFF, Nachr. Deut. Malak. Ges., vol. 29, pp. 127–9.
1898. *Cochlostyla dubiosa batanica* MÖLLENDORFF, Abhand. Naturf. Ges. Görlitz, vol. 22, p. 113.
1901. *Cochlostyla batanica* HIDALGO, Obras Malac., p. 303, pl. 28, fig. 4.
1905. *Cochlostyla dubiosa batanica* MÖLLENDORFF, Kobelt and Winter, Semper Reix. Arch. Philip., vol. 10, pt. 7, p. 150, pl. 30. fig. 2.

The race from the island of Batan averages a little smaller in all dimensions than *Cochlostyla dubiosa capulensis*. It is also less brilliantly colored with the incised spiral lines a little more strongly developed.

The specimen figured is an average specimen, collected by Quadras at Santo Domingo de Vasco. It has 4.5 whorls and measures—height, 28.9 mm.; greater diameter, 33.2 mm.; lesser diameter, 25.1 mm.

COCHLOSTYLA DUBIOSA CAPULENSIS, new subspecies

Plate 1, Figures 5–8

This race from the island of Capul is the most elegant of the three. The lines of growth and incised spirals are fewer than in the other two races, and the shell has a smoother aspect. Here too the brown band at the summit is narrow, while those above and below the periphery are broad. The umbilical area is not darker than the rest of the base. The ground color of the last turn is bright horn colored where the diaphanous bands have been worn away. The early turns are white, the middle ones flesh colored with a pale zone of brown at the summit and the suture.

The type, Cat. No. 315731, U.S.N.M., an average specimen, has 4.8 whorls and measures—height, 32.0 mm.; greater diameter, 33.1 mm.; lesser diameter, 26.9 mm.

COCHLOSTYLA SUBMIRABILIS Möllendorff

This species as we have mentioned under *Cochlostyla dubia* Pfeiffer has been in part confused with that species and some of the races have been confounded with *Cochlostyla mirabilis* Ferussac. From *Cochostyla dubia* it is distinguished by the extremely reduced, practically absent, incised spiral lines, while the presence of hydrophanous spiral bands distinguish it from *Cochlostyla mirabilis* Ferussac.

Cochlostyla submirabilis Möllendorf appears confined to southern Luzon, ranging from the south side of Laguna de Bay to Albay Province. It appears to be a species that easily responds to local environment, and therefore breaks up into quite a number of races.

These races present variations that range in shape from ovoid to helicoid; some are unicolor, that is, excepting the hydrophanous lines and zones, which are found on the entire surface of its shell. Others may have only a dark chesnut colored area about the umbilicus, still others may have in addition a dark band at the summit. A peripheral dark zone is present in some and an additional spiral band of chesnut may be present between summit and periphery. These spiral bands vary in width also. The most highly banded form has therefor a dark umbilical area, a peripheral zone, one between periphery and summit, and another at the summit.

From north southward I recognize the following races:

Cochlostyla submirabilis banosana from the mountains near Los Banos, Laguna Province.

Cochlostyla submirabilis majayjayana from the northwest watershed of Mount Banahao, Majayjay, Laguna Province.

Cochlostyla submirabilis lucbana from the east slope of the Mount Banahao complex.

Cochlostyla submirabilis tayabasana from the south slope of the Mount Banahao complex at Tayabas.

Cochlostyla submirabilis antimonana from the region about Antimonan a little south of the middle of the western shore of Lamon Bay.

Cochlostyla submirabilis submirabilis Möllendorff from Lopez east of the southeastern end of Lamon Bay.

Cochlostyla submirabilis daragana from Daraga, Albay Province.

In addition to these we will probably have to recognize a race from Mount Maquiling, of which I have only dead bones too poor to furnish a description. These shells are nearest related to *Cochlostyla majayjayana.*

Another shell, also very dead, which I collected at Mariveles may, if an indigenous race, need a name. It may, however, be a hermit crab carried individual.

These races may be briefly diagnosed as follows:

COCHLOSTYLA SUBMIRABILIS BANOSANA, new subspecies

Plate 2, Figures 1–4

Shell small, subglobular, rather heavy, with the whorls decidedly rounded. Early whorls brown, the last turn and a half yellow orange, darkening toward the aperture. Peristome white, inside of aperture bluish white. No dark bands are present nor is there

a dark umbilical area. The hydrophanous bands are mostly worn away in the type, they are of varying width, the broadest being at the summit.

The type, Cat. No. 311075, U.S.N.M., has almost 5 whorls and measures—height, 29.2 mm.; greater diameter, 31.7 mm.; lesser diameter, 26.0 mm.

The type comes from the mountains near Los Banos, Laguna Province, Luzon.

In size this subspecies resembles *Helix submirabilis lucbana*, but it is of much heavier texture and lacks the spiral color bands. It is also more elevated.

HELICOSTYLA SUBMIRABILIS MAJAYJAYANA, new subspecies

Plate 2, Figures 5–8

Shell subglobose of strong texture. Whorls quite strongly rounded. The ground color varies from straw color to pale brown, the earlier whorls usually being darker than the rest. The umbilical area is bordered by a dark zone and a broad dark band is present at the summit of the whorls. The entire surface of spire and base is marked by hydrophanous spiral bands as shown in our figures.

The type and four additional specimens were collected by Francisco Rivera at Majayjay, Laguna Province, Luzon. I also collected it above the falls at Botocan, not far from Majayjay.

The type, Cat. No. 312943, U.S.N.M., has 5.1 whorls and measures—height, 35.7 mm.; greater diameter, 36.4 mm.; lesser diameter, 29.6 mm.

The largest specimen has 5.0 whorls and measures—35.1 mm.; greater diameter, 41.2 mm.; lesser diameter, 32.2 mm. The smallest specimen has 5 whorls and measures—height, 35 mm.; greater diameter, 34.7 mm.; lesser diameter, 28.8 mm.

This is the largest of the globular races. It is brilliantly colored. It most nearly resembles *Cochlostyla submirabilis tayabasana*, from which it is easily distinguished by its much larger size.

Paratypes are in the collection of the Philippine Bureau of Science.

COCHLOSTYLA SUBMIRABILIS LUCBANA, new subspecies

Plate 2, Figures 9–12

Shell small, subglobular, rather thin, early whorls light or dark, ground color of the later whorls olivaceous straw colored. There is a dark umbilical area and a dark band at the suture. Peristome white. Interior of aperture bluish white. The hydrophanous spiral zones are of very variable width, the broadest being at the summit.

The type, Cat. No. 47901, U.S.N.M., has 4.5 whorls and measures—height, 28.0 mm.; greater diameter, 30.3 mm.; lesser diameter, 24.5 mm. It was collected at Lucban, Tayabas Province, Luzon.

In size this race resembles *Cochlostyla submirabilis banosana*. The spire here, however, is less elevated, the whorls more inflated, and the shell of much thinner texture.

COCHLOSTYLA SUBMIRABILIS TAYABASANA, new subspecies

Plate 3, Figures 1–4

Shell subglobose, quite thin, whorls inflated, well rounded. Early whorls brown, straw, or flesh colored, the succeeding turns may be straw colored, light or darker brown. The umbilical area is dark chestnut brown and a spiral band of the same color marks the summit. Peristome white. Interior of aperture bluish white. The hydrophanous spiral bands are of varying width, the widest being at the summit, as may be seen by our figures.

The type, Cat. No. 195436, U.S.N.M., has almost 5 whorls and measures—height, 36.0 mm.; greater diameter, 35.7 mm.; lesser diameter, 28.4 mm. It and three additional specimens collected by Von Möllendorff at Tayabas, Tayabas Province, Luzon, were distributed by him under the name of *Cochlostyla dubiosa* Pfeiffer.

The subspecies most nearly resembles *Cochlostyla submirabilis majajajana*, from which it differs by its smaller size, less elevated spire, and much thinner shell.

COCHLOSTYLA SUBMIRABILIS ANTIMONANA, new subspecies

Plate 3, Figures 5–8

Shell broadly ovate, rather heavy. Nuclear whorls pale brown, the succeeding whorls flesh colored, the last two straw-colored, deepening to pale orange near the aperture. The umbilical area has a narrow dark zone. A broad peripheral spiral band, a narrow one at the summit and one of intermediate width halfway between these are present. The peristome, which is rather obliquely protracted and flaring, is white and thick. The last turn shows numerous fine spiral hydrophanous lines. Where the thin periostracum has been removed the shell shows white.

The type, Cat. No. 392948, U.S.N.M., comes from the Quadras collection and was obtained at Antimonan, Tayabas Province, Luzon. It has 5.1 whorls and measures—height, 47.8 mm.; greater diameter, 40.2 mm.; lesser diameter, 32.7 mm.

The name bestowed upon it by Quadras was *Helicostyla dubiosa submirabilis*.

This subspecies diverges more than any other in the direction of elevation from the type that I have seen, being much more elevated than typical *Cochlostyla submirabilis submirabilis*. It goes as far in this extreme as those previously referred to tend toward depression.

Its broadly ovoid shape and large size differentiate from all the other subspecies.

COCHLOSTYLA SUBMIRABILIS DARAGANA, new subspecies

Plate 3, Figures 9–12

Shell helicoid, thin. Early whorls pale straw colored, the later of a more greenish yellow tinge, base still darker. Umbilical area pale brown, peripheral band bright chestnut brown, the narrow zone at the summit and the spiral band between this and the periphery a little paler than the peripheral zone. Peristome broadly expanded and somewhat protracted at the junction of the basal and outer lip, white. Inside of aperture bluish-white excepting the areas where the dark bands described above show through. The periostracum is thin and shows many fine, more or less wavy, spiral hydrophanous lines on spire and base.

The type, Cat. No. 312949, U.S.N.M., comes from the Quadras collection, where it bore the name *Helicostyla mirabilis*. It was collected at Daragua, Albany Province, Luzon. It has 4.5 whorls and measures—height, 33.0 mm.; greater diameter, 33.3 mm.; lesser diameter, 26.6 mm.

This subspecies resembles most nearly *Cochlostyla submirabilis submirabilis* from which it differs by its much thinner shell, much more depressed spire, and longer aperture.

COCHLOSTYLA SUBMIRABILIS SUBMIRABILIS Möllendorff

Plate 4, Figures 1–4

1891. *Cochlostyla dubiosa* HIDALGO, Obras. Malac., pp. 313–5, pl. 47, fig. 4
1897. *Cochlostyla dubiosa submirabilis* MÖLLENDORFF, Nachr. Deut. Malak. Ges., vol. 29, p. 128.
1898. *Cochlostyla dubiosa submirabilis* MÖLLENDORFF, Abhand. Naturf. Ges. Görlitz, vol. 22, p. 113.
1905. *Cochlostyla dubiosa submirabilis* MÖLLENDORFF, Kobelt and Winter, Semper. Reis. Arch. Philip., vol. 10, pt. 1, p. 151, pl. 30, fig. 3.

Shell ovate, rather thin. Early whorls flesh colored or pale brown. The succeeding turns straw-colored, deepening to brownish straw color on the last whorl. Umbilical area with a narrow brown zone. Periphery marked by a brown band; there is also a narrow zone of brown at the summit and another halfway between this and the

periphery. Peristome white, protracted at the junction of the outer and basal lip. Interior of aperture pearl gray excepting the dark spiral bands described above. There are many hydrophanous spiral lines and zones which are well shown in our figures.

The specimen figured, Cat. No. 195390, U.S.N.M., is one of four from the Möllendorf collection which came from Lopez, Tayabas Province, Luzon. It has 5.1 whorls and measures—height, 38.8 mm.; greater diameter, 33.8 mm.; lesser diameter, 28.7 mm.

This subspecies stands halfway between *Cochlostyla submirabilis antimonana* and *Cochlostyla submirabilis daragana* in shape.

COCHLOSTYLA MIRABILIS Ferussac

This species, like *Cochlostyla dubia* Pfeiffer, has also been battered from pillar to post and from almost its inception has been made the recipient of a number of subspecies belonging to *Cochlostyla persimilis* which in turn has been badly confused with what we are here calling *Cochlostyla submirabilis* Möllendorff.

In *Cochlostyla mirabilis* Ferussac the periostracum is almost wanting, the merest film of it, yellowish tinged, is present on the last portion of the shell and on the parietal wall of the aperture. In *Cochlostyla persimilis* the periostracum is always strongly developed on the last turn, ranging from straw colored to orange. Most writers appear to have considered *Cochlostyla mirabilis* typical to have lost the periostracum. That this is not the case is vouched for by the fact that the umbilical callus would have glazed over the part occupied by it and thus preserved this intact, which is not the case.

COCHLOSTYLA MIRABILIS MIRABILIS, Ferussac

Plate 4, Figures 5–10; Plate 5, Figures 1–6

1821. *Helix mirabilis* Ferussac, Tab. Syst. Anim. Moll., p. 47.
1821. *Helix mirabilis* Ferussac, Hist. Nat. Moc., pl. 31, figs. 4–6.
1822. *Helix galactites* Lamarck, Anim. Sans. Vert., vol. 6, p. 69.
1828. *Helix formosa* Wood, Ind. Test., Suppl., pl. 7, fig. 10.
1837. *Helicostyla galactites* Beck, Index Mol., p. 37.
1841. *Helix mirabilis* Sowerby, Proc. Zool. Soc. London, pp. 1–2.
1842. *Helix decipiens* Reeve, Conch. Syst., vol. 2, pl. 163, fig. 3.
1846. *Helix mirabilis* Pfeiffer, Martini-Chemnitz, Conch. Cab., ed. 2, vol. 1, pt. 12, p. 289, in part; pl. 48, figs. 5?, 6, 7?.
1848. *Helix mirabilis* Pfeiffer, Monogr. Helic. vivent., vol. 1, pp. 220–1, in part.
1850. *Helicostyla mirabilis* Albers, Heliceen, ed. 1, p. 104.
1850. *Helix galactites* Chenu, Conch. Ill., pl. 3, figs. 16, 16*a*, 17.
1851. *Helix galactites* Deshayes, Fer. Hist. Nat. Mol., vol. 1, pp. 319–20, in part, pl. 31, figs. 4–6.
1851. *Helix galactites* Reeve, Conch. Icon., pl. 12, figs. 45*a*, 45*b*, 45*g*.
1853. *Helix galactites* Pfeiffer, Mon. Helic. vivent., vol. 3, p. 172, in part.
1856. *Helicostyla mirabilis* Pfeiffer, Malacozool. Blät., vol. 2, p. 145.

1858. *Helicostyla mirabilis* H. and A. ADAMS, Gen. Rec. Mol., vol. 2, p. 192.
1859. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent., vol. 4, p. 206, in part.
1860. *Helicostyla mirabilis* MARTENS, Albers, Heliceen, ed. 2, p. 175.
1867. *Cochlostyla mirabilis* MARTENS, Preus. Exp. Ost. Asiat. Zool., p. 89, in part.
1868. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent., vol. 5, p. 274, in part.
1870. *Cochlostyla mirabilis* SEMPER, Reis. Phil., pt. 2, vol. 3, p. 192, in part.
1876. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent., vol. 7, p. 318, in part.
1880. *Cochlostyla mirabilis* KOBELT, Ill. Conchyl., vol. 2, p. 256, pl. 78, fig. 5.
1881. *Cochlostyla mirabilis* PFEIFFER, Clessin Nomenclator, p. 205.
1887. *Cochlostyla mirabilis* HIDALGO, Journ. Conchyl., vol. 35, p. 144.
1891. *Cochlostyla mirabilis* PILSBRY, Tryon Man. Conch., ser. 2, vol. 7, pp. 181–3, pl. 57, figs. 83, 86.
1894. *Helicostyla mirabilis* PILSBRY, Man. Conch., ser. 2, vol. 9, p. 224.
1898. *Cochlostyla mirabilis* MÖLLENDORFF, Abhand. Naturf. Ges. Görlitz, vol. 22, p. 113, in part.
1901. *Cochlostyla mirabilis* HIDALGO, Obras Malac., p. 441, in part, pl. 49, figs. 1, 2, 3, 5.
1905. *Cochlostyla mirabilis* MÖLLENDORFF, Kobelt and Winter, Semper Reis. Arch. Philip., vol. 10, pt. 7, pp. 151–3.

Cochlostyla mirabilis Ferussac as figured by him is represented by our Figures 5–7 on Plate 4. This shell is white excepting the last half of the last turn which is pale yellow. The shell has a dark brown peripheral zone, a little paler narrower one at the summit and an intermediate one halfway between these. There is no definite dark area about the umbilicus, but the general coloration is of a little darker shade here. Some shells, like our Figures 8–10, Plate 4, lack all color bands. Figures 1–3, Plate 5, show a form in which a broad brown umbilical area with secondary bands is present, also a superipheral band within the aperture, while the band between the summit and periphery is absent. An extreme form of coloration is shown in Figures 4–6, Plate 5, where the spiral bands of brown become much expanded and completely cover the base.

This subspecies, represented by many specimens in our collection, comes from Albay Province, Luzon.

The specimen figured on Plate 4, Figures 5–7, representing Ferussac's figure, has 5 whorls and measures–height, 35.5 mm.; greater diameter, 31.1 mm.; lesser diameter, 26.1 mm.

It differs from *Cochlostyla mirabilis trichroa* Pilsbry by having the dark bands practically of the same shade of brown instead of light and dark spiral bands.

COCHLOSTYLA MIRABILIS TRICHROA Pilsbry

Plate 5, Figures 7–9

1851. *Helix mirabilis* REEVE, Conch. Icon., pl. 2, fig. 45*c*.
1851. *Helix mirabilis* DESHAYES, Fer. Hist. Nat. Mol., vol. 1, pp. 319–20, pl. 108*c*, figs. 3–4.
1853. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent., vol. 3, p. 172, in part.
1859. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent,, vol. 4, p. 206, in part.

1887. *Cochlostyla mirabilis* HIDALGO, Journ. Conchyl., vol. 35, p. 44, in part.
1891. *Cochlostyla mirabilis trichroa* PILSBRY, Man. Conch., ser. 2, vol 7, p. 182, pl. 31, fig. 38.
1894. *Helicostyla mirabilis trichroa* PILSBRY, Man. Conch., ser. 2, vol. 9, p. 224.
1898. *Cochlostyla mirabilis trichroa* MÖLLENDORFF, Abhand. Naturf. Ges. Görlitz, vol. 22, p. 113.
1901. *Cochlostyla mirabilis trichroa* HIDALGO, Obras. Malac., pt. 1, p. 443, in part.
1909. *Cochlostyla mirabilis trichroa* MÖLLENDORFF, Kobelt and Winter, Semper Reis. Arch. Philip., vol. 10, pt. 7, p. 152, pl. 30, fig. 5.

Pilsbry in diagnosing this subspecies[2] says: "Having four wide or narrow blackish-brown bands, and three yellowish-brown bands in their intervals." This characterization equally defines the form to-day.

The typical form, Pilsbry says, comes from Albay. This is represented by Figures 7–9 on Plate 5. In some of our shells the light brown band between the peripheral and median is absent. Such a shell we have from the Quadras collection from Libmanan, Ambos Camarines, Luzon.

COCHLOSTYLA PERSIMILIS Ferussac

The shape of the shell in this species varies from helicoid to ovate. The shell is covered by a well developed translucent periostracum, which in most instances is lemon yellow, but in some subspecies darker shades, even a pale brownish tinge, are present. The shells may be unicolor, a brown umbilical area may be present and in addition to this a peripheral zone of brown, a zone of brown at the summit and one between this and the periphery may be present. Any one of these elements may be absent, but as a rule the members of the various subspecies show a tendency to be constant in whatever phase of coloration they may have acquired. Hydrophanous bands are absent. The aperture varies considerably in shape, in some races being considerably protracted at the junction of its outer and basal lip. Peristome thickened, expanded and reflected, white.

All the races here described come from southern Luzon excepting *Cochlostyla persimilis boacana*, which comes from Marinduque.

COCHLOSTYLA PERSIMILIS PERSIMILIS Ferussac

Plate 6, Figure 7–9

1846. *Helix mirabilis* PFEIFFER, Martini-Chemnitz, Conch. Cab., ed. 2, vol. 1, pt. 12, p. 289, in part, pl. 48, fig. 8.
1850. *Helix persimilis* FERUSSAC, Hist. Nat. Mol., vol. 1, p. 320, pl. 108C, figs. 5 and 6.
1851. *Helix mirabilis* REEVE, Conchol. Icon., pl. 12, fig. 45*d*.
1853. *Helix persimilis* var. d. PFEIFFER, Mon. Helic. vivent., vol. 3, p. 172.
1859. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent, vol. 4, p. 206, in part.

[2] Man. Conch. ser. 2, vol. 7, p. 182.

1868. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent, vol. 5, p. 274, in part.
1876. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent, vol. 7, p. 318, in part.
1887. *Cochlostyla mirabilis* HIDALGO, Journ. Conchyl., vol. 35, p. 144, in part.
1894. *Helicostyla mirabilis* PILSBRY, Man. Conch., ser. 2, vol. 9, p. 224.
1898. *Cochostyla mirabilis persimilis* MÖLLENDORFF, Abhand. Naturf. Ges. Görlitz, vol. 32, p. 113.
1901. *Cochlostyla mirabilis* HIDALGO, Obras. Malac., p. 442, in part.
1901. *Cochlostyla boettgeriana* HIDALGO, Obras. Malac., p. 444, in part, pl. 50, fig. 6?.
1905. *Cochlostyla mirabilis* MÖLLENDORFF, Kobelt and Winter, Semper Reis. Arch. Philip., vol. 10, pt. 7, pp. 151–2.

Shell rather large, broadly ovate. Tip flesh colored, the succeeding turns yellow, slowly grading to pale brownish-yellow on the last part of the last whorl. Umbilical area brown, the brown may be obscured by the umbilical callus; peripheral, median, and band at the summit present, usually grading in shade in the order mentioned from dark to lighter. Aperture produced, peristome expanded, thickened and reflected, white. Interior of aperture bluish-white, excepting where the dark bands show through the substance of the shell.

The specimen figured, Cat. No. 312953, U.S.N.M., corresponds well with Ferrussac's illustration. It has 5.1 whorls and measures—height, 44.2 mm.; greater diameter, 38.9 mm.; lesser diameter, 32.5 mm. This is the largest of the races before me. Our material lacks a specific locality. The determination of its exact habitat will therefore have to be left to the future.

Its large size and ovate form readily distinguish it from the other known races.

COCHLOSTYLA PERSIMILIS CALLIPEPLA, new subspecies

Plate 6, Figures 1–3

1846. *Helix mirabilis* PFEIFFER, Martini-Chemnitz. Conch. Cab., ed. 2, vol. 1, pt. 12, pp. 288–9, in part, pl. 48, fig. 10.
1850. *Helix mirabilis* FERUSSAC, Hist. Nat. Mol., vol. 1, p. 319, in part, pl. 107A, figs. 1, 2.
1853. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent., vol. 3, p. 172, in part, pl. 108A, figs. 17? 18?.
1859. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent., vol. 4, p. 206, in part.
1867. *Cochlostyla mirabilis* MARTENS, Preus. Exp. Ost. Asiat., pp. 89–90, pl. 19, fig. 2.
1887. *Cochlostyla mirabilis* HIDALGO, Journ. Conchyl., vol. 35, p. 144, in part.
1891. *Cochlostyla mirabilis* PILSBRY, Tryon, Man. Conch., ser. 2, vol. 7, p. 182.
1898. *Cochlostyla mirabilis* MÖLLENDORFF, Abhand. Naturf. Ges. Gölitz, vol. 22, p. 113, in part.
1901. *Cochlostyla mirabilis* HIDALGO, Obras Malac, p. 443, in part.

Shell rather small, broadly ovate, early whorls white, succeeding turns pale green, grading to olivaceous-yellow on the last part of the last turn. In all our specimens the umbilical area is *not* dark. In

the type the peripheral, median, and brown band at the summit are present. Aperture rather effuse, peristome broadly expanded, thickened, and reflected, white.

The type, Cat. No. 312954, U.S.N.M., has 4.8 whorls and measures—height, 34.7 mm.; greater diameter, 32.0 mm.; lesser diameter, 27.0 mm. Seven additional specimens seem to vary little from these dimensions.

The type was collected by Cuming at Albay, Albay Province, Luzon.

In one of our specimens the median spiral band of brown is absent, while in another it is indicated by a mere trace. Still another individual lacks all bands.

This is the smallest of the known races excepting *Cochlostyla persimilis acrybia* from which it can be distinguished at a glance by its different form.

COCHLOSTYLA PERSIMILIS PHARCIDA, new subspecies

Plate 6, Figures 4–6

Shell small, thin, ovate. Early whorls white, grading gradually through yellow to olivaceous yellow in the last part of the last turn. An obscure, narrow, darkish area is present in the umbilical region, while the peripheral band is also faint and the median and band at the summit are scarcely indicated. Aperture effuse anteriorly, peristome expanded, thickened and reflected, with the interior of aperture bluish-white. The real distinguishing feature of this race, however, is the decidedly malleated surface of the last rurn.

The type, Cat. No. 105286*a*, U.S.N.M., comes from Albay Province, Luzon. It has 5 whorls and measures—height, 37.3 mm.: greater diameter, 31.5 mm.; lesser diameter, 26.4 mm.

The malleated surface combined with the ovoid shape will differentiate this from the other race.

COCHLOSTYLA PERSIMILIS DONSALANA Bartsch

Plate 7, Figures 1–3

1918. *Cochostyla mirabilis donsalana* BARTSCH, Proc. Biol. Soc. Wash., vol. 31, pp. 153–4.

Shell elongate-ovate, moderately thick, early whorls white, grading through wax yellow to pale olive at the aperture. The shell may be without bands, or a mere line of brown may be present at the summit and another halfway between this and the periphery. No dark area bounds the umbilicus. Aperture very oblique and effuse anteriorly; peristome expanded and reflected, white. Interior of aperture bluish-white.

The type, Cat. No. 219021, U.S.N.M., has 5 whorls and measures—height, 43.6 mm.; greater diameter, 35.6 mm.; lesser diameter, 30.0 mm.

The elongate form, very oblique, aperture and reduced color bands characterize this race, which comes from Donsal, Sorsogon Province, Luzon.

COCHLOSTYLA PERSIMILIS CALLIMORPHA, new subspecies

Plate 7, Figures 4–9

1851. *Helix mirabilis* REEVE, Conch. Icon., pl. 12, fig. 45*c*.
1851. *Helix mirabilis*, FERUSSAC, Hist. Nat. Mol., vol. 1, pp. 319–320, in part, pl. 108C, figs. 8, 9.
1853. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent., vol. 3, p. 172, in part, pl. 110B, fig. 2.
1859. *Helix mirabilis* PFEIFFER, Mon. Helic. vivent., vol. 4, p. 206, in part.
1887. *Cochlostyla mirabilis* HIDALGO, Journ. Conchyl., vol. 35, p. 144, in part.
1907. *Cochlostyla mirabilis* HIDALGO, Obras. Malac., p. 444, in part.

Shell rather large, subglobose, early whorl pale brown or white, the later turns may be soiled white with a yellowish tinge, pale straw-colored, wax yellow, or almost orange in general tone. In all our shells there is a dark umbilical area and in all, even those that appear unicolor, at least a slender thread of brown is apparent at the summit. The peripheral zone of brown may be present or absent, the same is true of the spiral band between the periphery and the summit. All three spiral bands are broad and very pronounced in some shells. Aperture large, broad. Peristome expanded, thickened, and reflected, white.

I have selected a dark colored specimen as type, Cat. No. 312955, U.S.N.M., which is figured on Plate 7, Figures 4–6. This has 5 whorls and measures—height, 39.7 mm.; greater diameter, 34.6 mm.; lesser diameter, 29.8 mm. Another specimen showing the full banding is shown on Plate 7, Figures 7–9.

This race, which also comes from somewhere in Albay Province, Luzon, resembles most nearly *Cochlostyla persimilis callipepla*, from which its much larger size will distinguish it at once.

COCHLOSTYLA PERSIMILIS PODAGRA, new subspecies

Plate 8, Figures 7–9

Shell helicoid, thin. Early whorls pale yellow, the succeeding turns gradually becoming darker, grading to brownish green on the last portion of the last whorl. The area about the umbilicus is dark chestnut brown, a band of the same color marks the periphery and another of the same shade is a little nearer the peripheral band than the slightly paler one at the summit. In the type an additional, very pale brown zone is present halfway between the band at the

summit and the median band on the last two whorls. Aperture broad, peristome moderately expanded and reflected but only slightly thickened.

The type, Cat. No. 312957, U.S.N.M., bears the label Luzon. It has 4.7 whorls and measures—height, 34.3 mm.; greater diameter, 36.4 mm.; lesser diameter, 28.8 mm.

A young specimen which I believe belongs here was collected by Col. E. A. Mearns and bears the label Tibi and Pili Hot Spring, Albay Province, Luzon.

The helicoid form distinguishes this race from the others described.

COCHLOSTYLA PERSIMILIS ACRYBIA, new subspecies

Plate 8, Figures 4–6

1851. *Helix mirabilis*, Ferussac, Hist. Nat. Mol., vol. 1, pp. 319–20, pl. 108B figs. 9–10.

Shell small, ovate. Early whorls brown or white, the rest yellow with a brownish-orange tinge. Umbilical zone brown, peripheral and median bands broad, while the band at the summit is rather narrow. All bands dark chestnut brown. Aperture rather narrow; peristome and interior of aperture bluish white.

The type, Cat. No. 312958, U.S.N.M., has 5.1 whorls and measures—height, 34.2 mm.; greater diameter, 28.5 mm.; lesser diameter, 25.9 mm.

This subspecies suggests in form *Cochlostyla metaformis*, from which, of course, the columella will at once distinguish it. Its general shape is different from all other races described so that it can not be confused with them.

COCHLOSTYLA PERSIMILIS BOACANA, new name

Plate 8, Figures 1–3

1846. *Helix mirabilis* Pfeiffer, Martini-Chemnitz, Conch. Cab., ed. 2, vol. 1, pt. 12, pp. 288–9, in part, pl. 48, fig. 9.
1851. *Helix mirabilis* Reeve, Conch. Icon., pl. 12, fig. 45*f*.
1853. *Helix mirabilis* Pfeiffer, Mon. Helic. vivent., vol. 3, p. 172, in part.
1859. *Helix mirabilis* Pfeiffer, Mon. Helic. vivent, vol. 4, p. 206, in part.
1887. *Cochlostyla mirabilis* Hidalgo, Journ. Conchyl., vol. 35, p. 144, in part.
1891. *Cochlostyla mirabilis* Pilsbry, Man. Conch., ser. 2, vol. 7, p. 182, pl. 57, fig. 80.
1898. *Cochlostyla mirabilis crassa* Möllendorff, Abhand. Naturf. Ges. Görlitz, vol. 22, p. 113, not *Cochlostyla intoria crassa* Möllendorff, Berichte Senckenberg Naturf. Ges., p. 232. 1890.
1909. *Cochlostyla mirabilis* Möllendorff, Kobelt and Winter, Semper Reis. Arch. Phillip., vol. 70, pt. 7, pp. 152–3, pl. 30, fig. 6.

Möllendorff in creating *Cochlostyla mirabilis crassa* in 1898 failed to remember that he had already employed the name *crassa* in the

genus *Cochlostyla* in 1890 for *Cochlostyla intorta crassa*, which makes it necessary to rechristen it. I have selected the subspecific name *boacana* because most of the material in our collection has come from the vicinity of Boac.

This subspecies is characterized by having the dark bands exceedingly broad, their total surface sometimes equals or probably exceeds that of the light areas. As a rule, four zones are present, that is the umbilical, peripheral, intermediate, and the band at the summit. There is only one specimen in our collection in which this phase of coloration does not obtain. In this a narrow zone at the umbilicus and a very narrow line at the summit are dark colored. Even here, however, the other two bands are indicated as mere shadows. The periostracum varies considerably in tint, ranging from lemon yellow to pale brownish-orange. Peristome white. Interior of aperture bluish-white excepting the areas occupied by the dark spiral bands.

The specimen figured has 4.9 whorls and measures—height, 33.6 mm.; greater diameter, 32.8 mm.; lesser diameter, 27.0 mm. The largest specimen before me has 5.1 whorls and measures—height, 35.7 mm.; greater diameter, 34.8 mm.; lesser diameter, 30.1 mm. The smallest specimen has 4.6 whorls and measures—height, 27.0 mm.; greater diameter, 29.7 mm.; lesser diameter, 23.0 mm.

The extremely dark coloration distinguishes this race from all the others.

OBBA GALLINULA MAJAYJAYANA, new subspecies

Plate 4, Figures 11–13

Shell similar to *Obba gallinula convexospira* Möllendorff, differing from this by being less convex, that is, more depressed, by having the dorsal dark spiral band a little more median and the ventral dark spiral band broader and a little more median. The open umbilicus is also a trifle wider in our shells.

The type, Cat. No. 322962, U.S.N.M., and two paratypes in the collection of the Philippine Bureau of Science were collected by Dr. C. F. Baker. The type has 4.8 whorls and measures—height, 10.0 mm.; greater diameter, 26.9 mm.; lesser diameter, 22.0 mm. The paratypes have 4.9 and 4.6 whorls, respectively, and measure—height, 11.3 and 10.1 mm.; greater diameter, 27.3 and 27.4 mm.; lesser diameter, 22.4 and 23.3 mm., respectively.

LEPTOPOMA McGREGORI, new species

Plate 9, Figures 4–6

Shell small, helicoid, thin, yellowish horn colored. In the type a rather broad chestnut-brown band is present, which extends over the periphery and the posterior portion of the base, and a series

of distantly spaced brown spots from an interrupted band at the summit of the last turn. The nuclear whorls merge imperceptibly into postnuclear turns. The first half turn smooth, after which the sculpture characteristic of the succeeding whorls begins. Postnuclear whorls well rounded, marked by four strong spiral threads, which occupy the anterior two-thirds of the turns. The heaviest of these is at the periphery where it forms a decided keel; the other three, which are of equal strength, are also about equally spaced. In addition to this sculpture the whorls are marked by fine, quite regular, rather closely spaced spiral threads. The axial sculpture consists of fine, closely approximated, retractively slanting threads, which lend to the shell a silky luster. Base rather depressed, well rounded, marked by a cord equaling those posterior to the periphery and a little farther removed from the periphery than the first post peripheral cord is separated from this. The rest of the base is marked by closely spaced spiral threads, which are a little stronger than those on the spire. The base is narrowly openly umbilicated. Aperture large, subcircular; peristome white, very broadly flaringly expanded, marked by concentric lines of growth, the columellar portion being also reflected to more than half cover the umbilicus. Parietal wall glazed with a thin callus.

The type, Cat. No. 312965, U.S.N.M., was collected by R. C. McGregor, for whom I take pleasure to name it, on Mount Banahao, Luzon. It has 5 whorls, and measures—height, 10.0 mm.; greater diameter, 10.5 mm.; lesser diameter, 8.0 mm.

The paratype in the possession of the Philippine Bureau of Science lacks the spiral color band of the base, but has the series of brown spots described for the type continued as axial bands across the last three whorls where they extend to the periphery in a zigzag manner. This specimen is a little larger than the type. It has lost the early whorls. It measures—greater diameter, 11.4 mm.; lesser diameter, 9.0 mm.

This species approximates *Leptopoma cuticulare* Möllendorff. A specimen of this collected by Quadras at Mount Limuton, Morong District, can be distinguished at once from the present race by the presence of a second strong spiral cord on the base.

SULFURINA CITRINELLA BANAHAOANA, new subspecies

Plate 9, Figures 1–3

Shell similar to *Sulfurina citrinella pagbilaoensis* Bartsch but a little more convex and in every way larger; also of much darker coloration, the shade here being pale orange.

The type, Cat. No. 312966, U.S.N.M., has 4.5 whorls and measures—height, 6.4 mm.; greater diameter, 9.0 mm.; lesser diameter, 7.0 mm.

An additional specimen, Cat. No. 312967, U.S.N.M., is also in the collection of the National Museum, while two paratypes are in the collection of the Philippine Bureau of Science.

The specimens were collected by R. C. McGregor on Mount Banahao, Luzon.

Plate 9, Figures 7–9, illustrates *Sulfurina citrinella pagbilaoensis* for comparison.

EXPLANATION OF PLATES

All figures are somewhat reduced, excepting Plate 9, in which the figures are much enlarged

PLATE 1

FIGS. 1–4. *Cochlostyla dubiosa dubiosa* Pfeiffer.
5–8. *Cochlostyla dubiosa capulensis* Bartsch.
9–12. *Cochlostyla dubiosa volubilis* Reeve.

PLATE 2

FIGS. 1–4. *Cochlostyla submirabilis banosana* Bartsch.
5–8. *Cochlostyla submirabilis majayjayana* Bartsch.
9–12. *Cochlostyla submirabilis lucbana* Bartsch.

PLATE 3

FIGS. 1–4. *Cochlostyla submirabilis tayabasana* Bartsch.
5–8. *Cochlostyla submirabilis antimonana* Bartsch.
9–12. *Cochlostyla submirabilis daragana* Bartsch.

PLATE 4

FIGS. 1–4. *Cochlostyla submirabilis submirabilis* Möllendorff.
5–7. *Cochlostyla mirabilis mirabilis* Ferussac (after Ferussac).
8–10. *Cochlostyla mirabilis mirabilis* Ferussac (lacking color bands).
11–13. *Obba gallinula majayjayana* Bartsch.

PLATE 5

FIGS. 1–3. *Cochlostyla mirabilis mirabilis* Ferussac (extreme of coloration).
4–6. *Cochlostyla mirabilis mirabilis* Ferussac (extreme of coloration).
7–9. *Cochlostyla mirabilis trichroa* Pilsbry.

PLATE 6

FIGS. 1–3. *Cochlostyla persimilis callipepla* Bartsch.
4–6. *Cochlostyla persimilis pharcida* Bartsch.
7–9. *Cochlostyla persimilis persimilis* Ferussac.

PLATE 7

FIGS 1–3. *Cochlostyla persimilis donsalana* Bartsch.
4–6. *Cochlostyla persimilis callimorpha* Bartsch. Type.
7–9. *Cochlostyla persimilis callimorpha* Bartsch. (Showing full banding.)

PLATE 8

FIGS. 1–3. *Cochlostyla persimilis boacana* Bartsch.
4–6. *Cochlostyla persimilis acrybia* Bartsch.
7–9. *Cochlostyla persimilis podagra* Bartsch.

PLATE 9

FIGS. 1–3. *Sulfurina citrinella banahaoana* Bartsch.
4–6. *Leptopoma megregori* Bartsch.
7–9. *Sulfurina citrinella paybilaoensis* Bartsch.

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LAND SHELLS FROM THE ISLAND OF LUZON

FOR EXPLANATION OF PLATE SEE PAGE 19.

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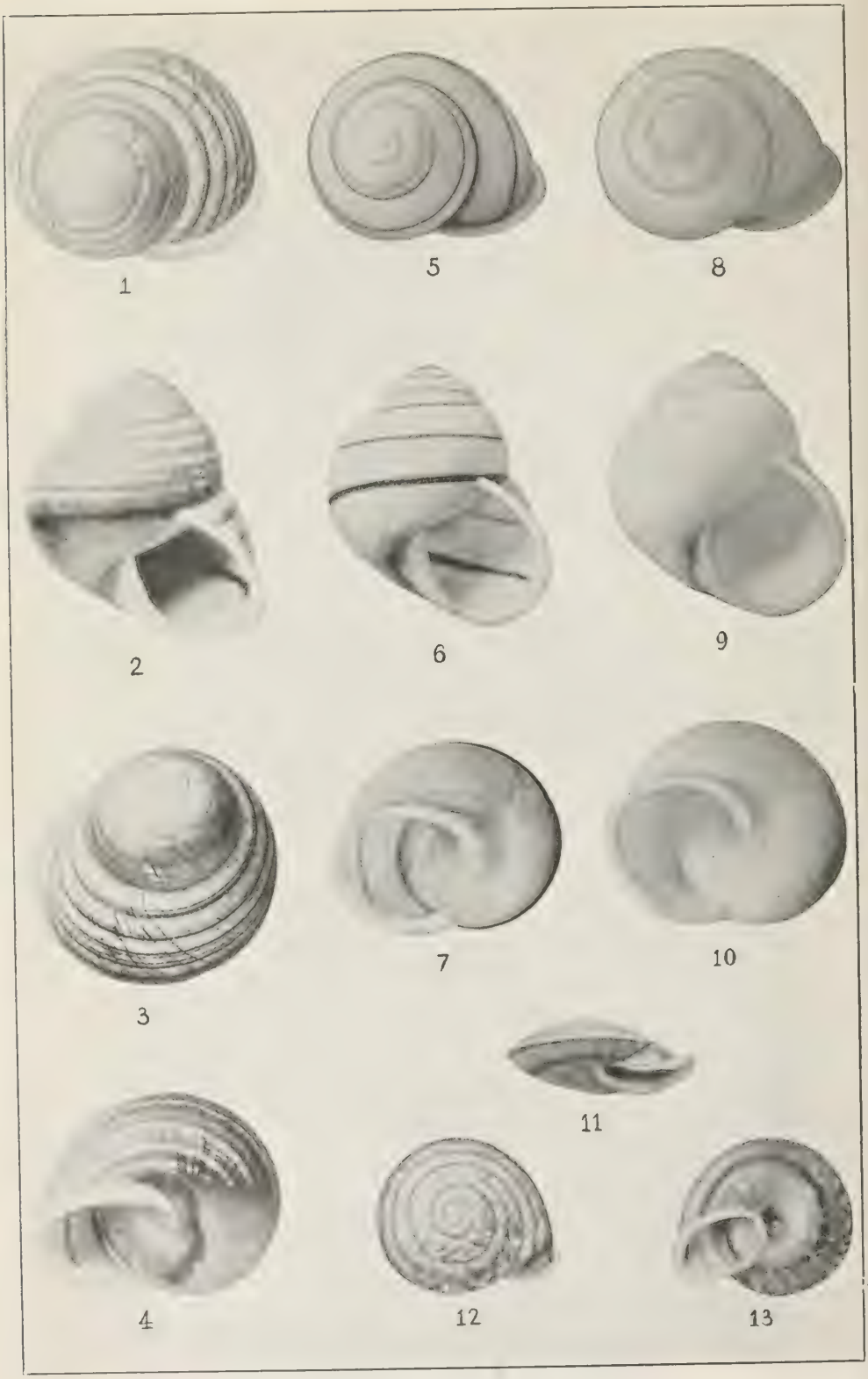

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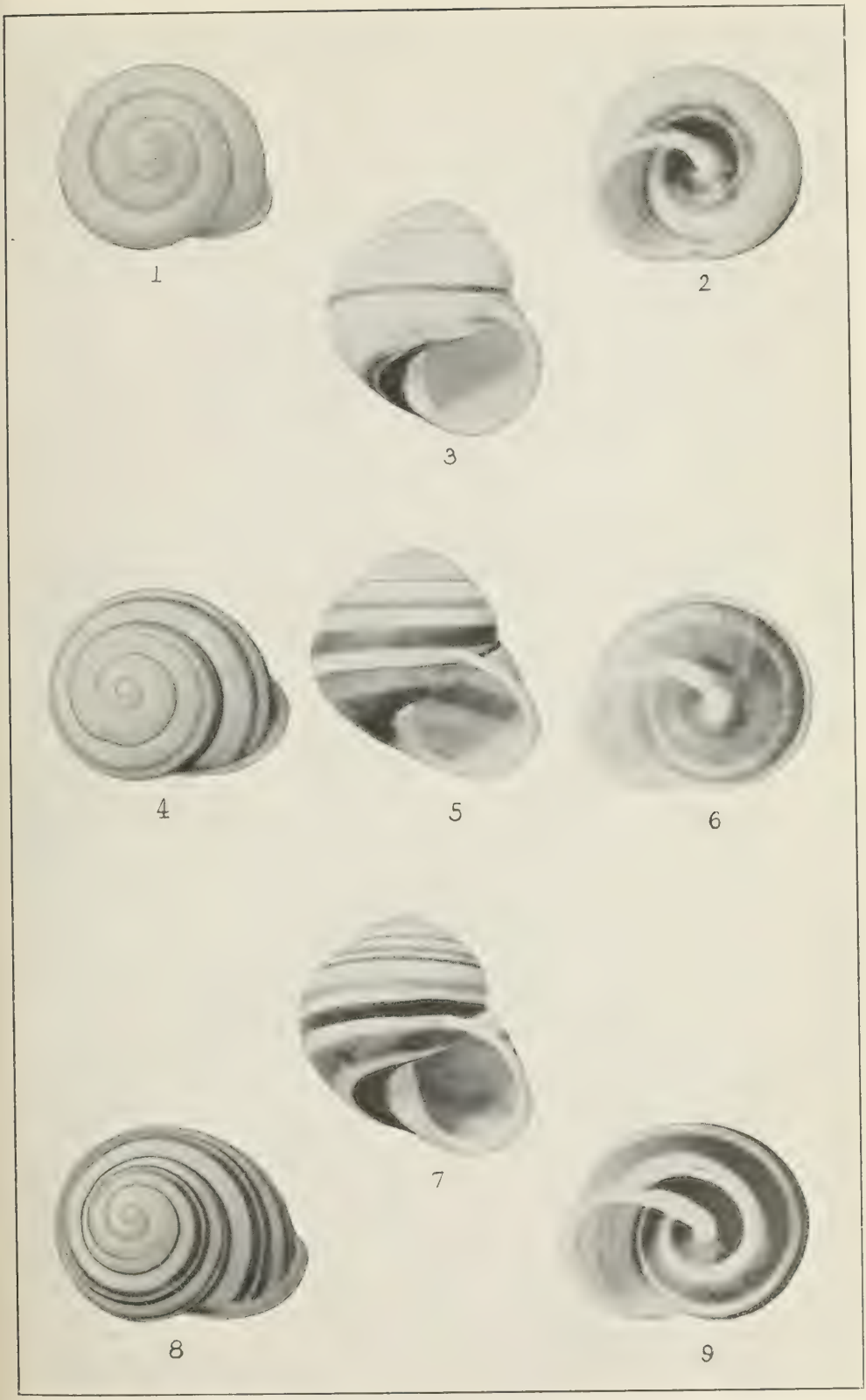

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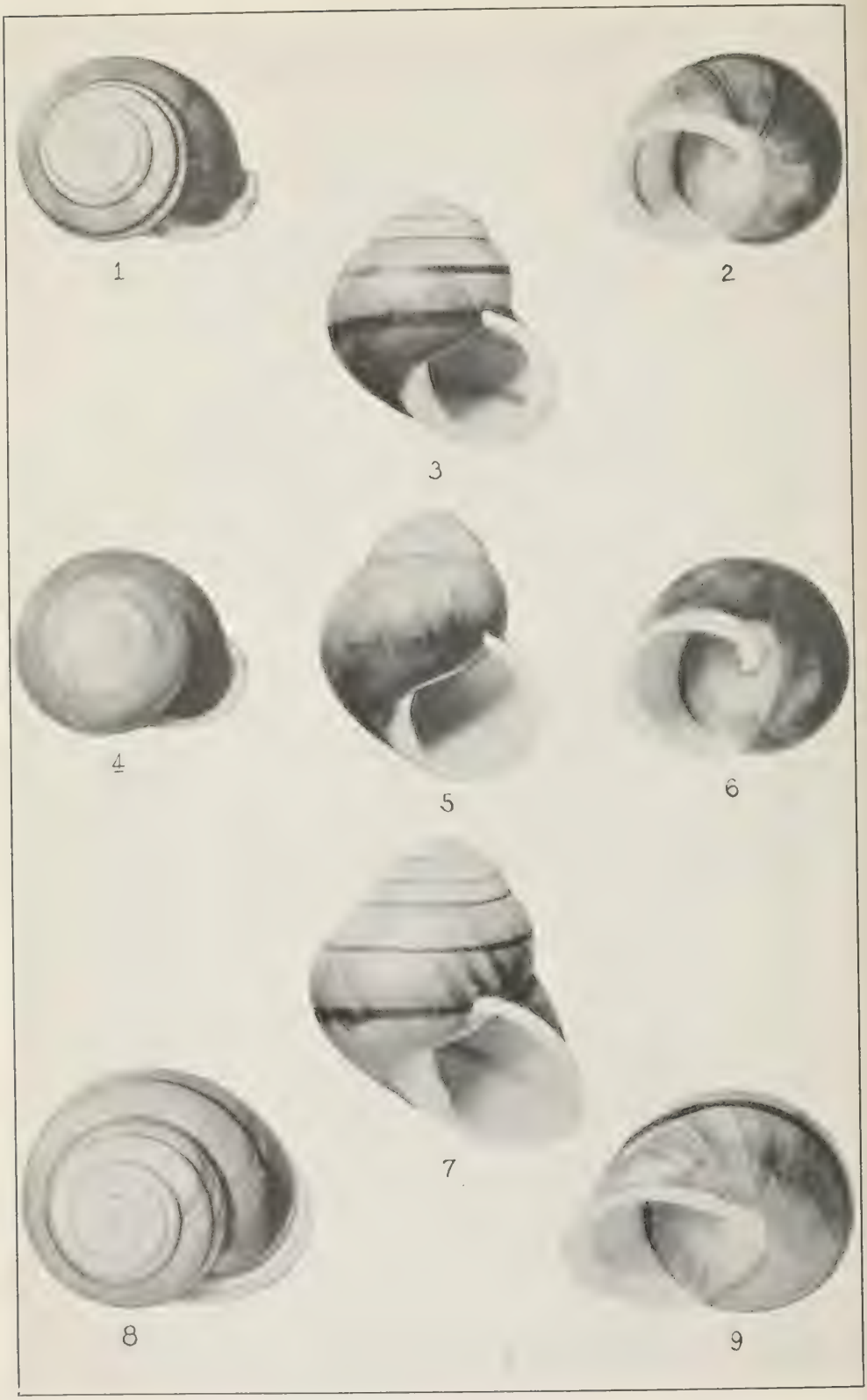

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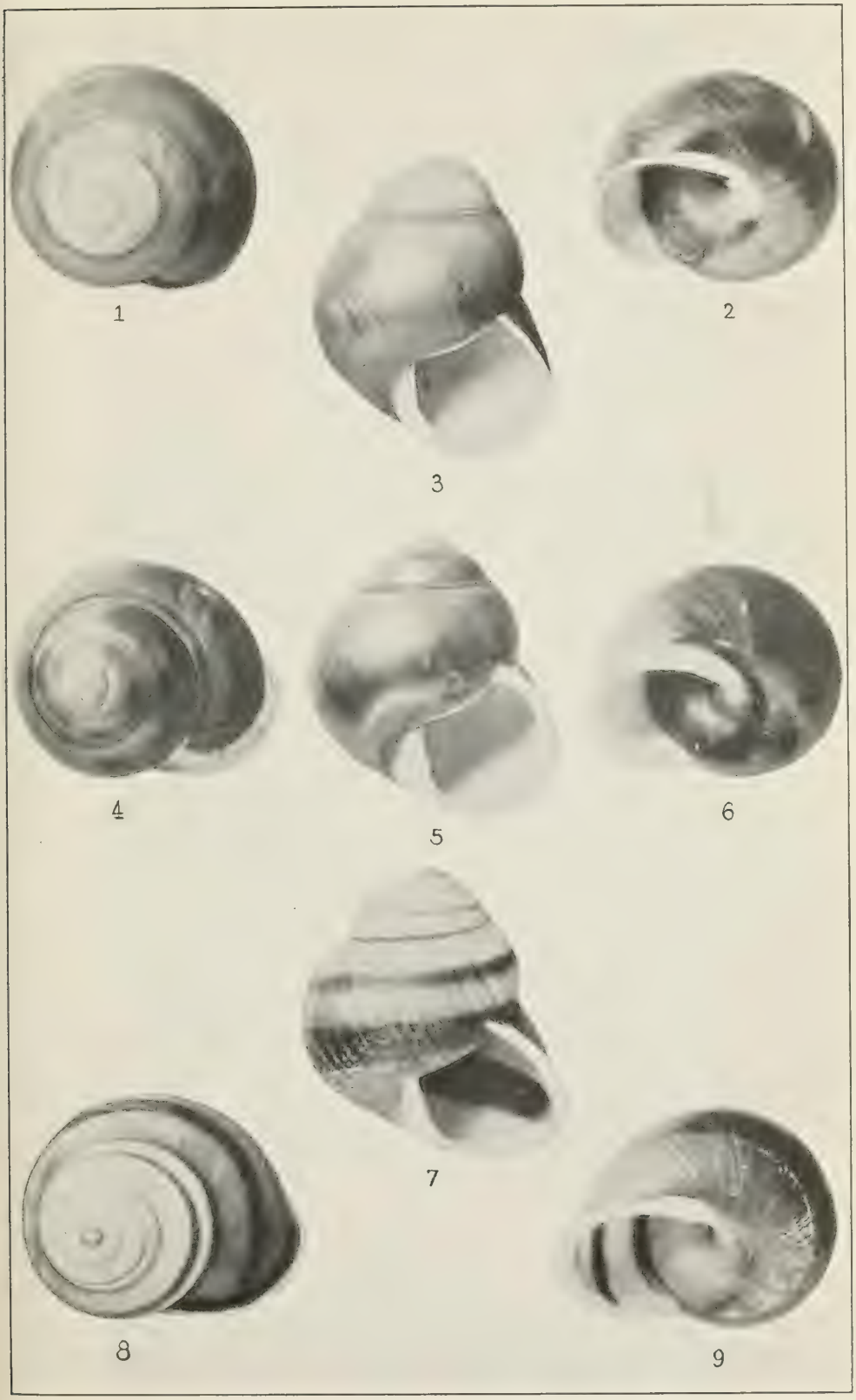

LAND SHELLS FROM THE ISLAND OF LUZON

FOR EXPLANATION OF PLATE SEE PAGE 20.

LAND SHELLS FROM THE ISLAND OF LUZON

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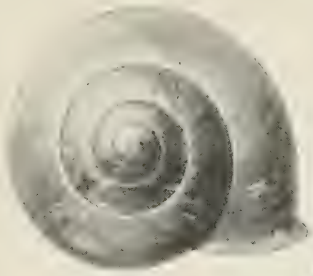
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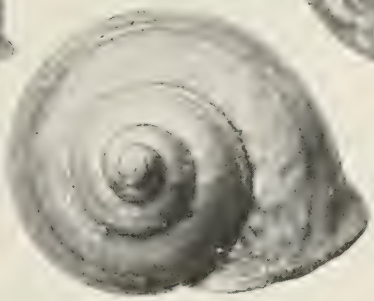
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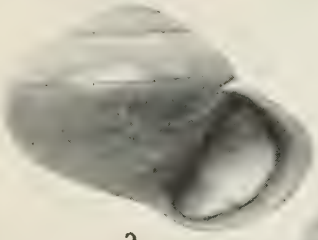
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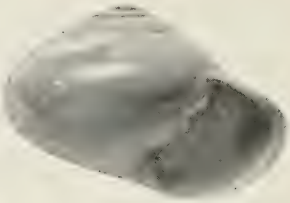
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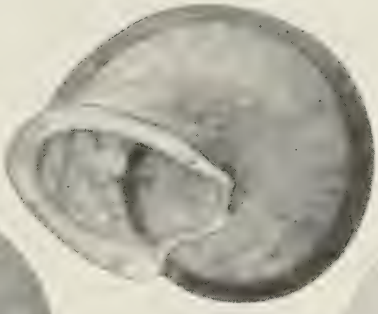
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LAND SHELLS FROM THE ISLAND OF LUZON

FOR EXPLANATION OF PLATE SEE PAGE 20.

THE SOUTH AMERICAN LIZARDS IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM

By Charles E. Burt and May Danheim Burt
Of Trinity University, Waxahachie, Texas

INTRODUCTION

During the course of our recent study of the South American lizards[1] we have examined the interesting collection contained in the United States National Museum. In it we find a new species from Argentina, which is described below as *Plica stejnegeri*, and numerous other specimens. Although the latter serve as representatives of previously described species, many of the variations and peculiarities are found to be of sufficient systematic importance to warrant an elaboration here. Moreover, many of the distributional records are new.

Recently Amaral (1925) has prepared an interesting and comprehensive account of the South American snakes in the collection of the United States National Museum, which we now follow with our contribution pertaining to the lizards.

We wish to express here our appreciation to Dr. L. Stejneger for permission to prepare this report and for the loan of valuable specimens, and to Miss Doris M. Cochran for placing every available facility at our disposal while we were at the United States National Museum. Furthermore, we are indebted to both for helpful criticisms and additions to the manuscript. The senior author is also indebted to the authorities of the American Museum of Natural History for permission to undertake this study while a staff member of that institution.

[1] Additional details pertaining to certain taxonomic modifications that are incorporated in the present report will be found a second contribution, entitled the "South American Lizards in the Collection of the American Museum of Natural History." This work will appear in a forthcoming issue of the Bulletin of the American Museum of Natural History.

Family GEKKONIDAE

Genus GONATODES Fitzinger

GONATODES ALBOGULARIS (Duméril and Bibron)

1836. *Gymnodactylus albogularis* DUMÉRIL and BIBRON, Erp. Gén., vol. 3, p. 415 (type locality, Martinique and Cuba).
1885. *Gonatodes albogularis* BOULENGER, Cat. Liz. Brit. Mus., vol. 1, p. 59.

The writer agrees with Stejneger (1917) that the United States National Museum specimens from Curaçao, No. 13859 (seven individuals), collected February 10–18, 1884, by the United States Fish Commission steamer *Albatross*, should be referred to *albogularis*, rather than to *fuscus* or *vittatus*.

GONATODES ARTRICUCULLARIS Noble

1921. *Gonatodes atricucullaris* NOBLE, Ann. New York Acad. Sci., vol. 29, p. 135 (type locality, Bellavista, Peru).

Peru.—Eleven specimens, Nos. 64039–44 and 75941–45 (*paratypes*), collected at Bellavista by G. K. Noble.

GONATODES VITTATUS (Lichtenstein)

1856. *Gymnodactylus vittatus* LICHTENSTEIN, Nomenclator Zool. Berol., p. 6 (type locality, "Laguayra, Puerto-Cabello, and Caracas," Venezuela).
1885. *Gonatodes vittatus* BOULENGER, Cat. Liz. Brit. Mus., vol. 1, p. 60.

The specimens of this species in the collection of the United States National Museum may be listed as follows:

No.	Locality	Date	Collector
27819–20	San Julian, Venezuela	July 19, 1900	M. W. Lyon, jr., and W. Robinson.
76809–13	Puerto La Cruz, Venezuela	Dec. 4, 1928	J. S. C. Boswell.
48732	La Guaira, Venezuela (*topotype*).		
71051	Caracas, Venezuela (*topotype*).		H. Pittier.

Genus GYMNODACTYLUS Spix

GYMNODACTYLUS HORRIDUS Burmeister

1861. *Gymnodactylus horridus* BURMEISTER, Reise La Plata, vol. 2, p. 522 (type locality, Mendoza, Argentina).—BOULENGER, Proc. Zool. Soc. London, 1889, p. 143.

Argentina.—Four specimens, No. 12411 (two examples), collected at Buenos Aires, No. 52597, secured at Mendoza, *the type locality*, by Dr. Carlos S. Reed, and No. 73502, from Argentina collected by the Breyer brothers.

Genus HEMIDACTYLUS Oken

HEMIDACTYLUS MABOUIA (Moreau de Jonnès)

1818. *Gecko mabouia* MOREAU DE JONNÈS, Bull. Soc. Philom., Paris, p. 138 (type locality, South America).

1836. *Hemidactylus mabouia* DUMÉRIL and BIBRON, Erp. Gén., vol. 3, p. 362.

Brazil.—Six specimens, No. 52612, collected at Bahia on July 27, 1915, by J. N. Rose, No. 52603, collected at the base of Corcovado on August 4, 1915, by J. N. Rose, No. 52601, secured at Rio de Janiero in July, 1915, by J. N. Rose, No. 71076, collected at Santos in September, 1925, by W. L. Schmidt, and No. 5679 (2 specimens) from Rio de Janiero taken by the United States Exploring Expedition.

Genus PHYLLODACTYLUS Gray

PHYLLODACTYLUS ABRUPTESERIATUS Werner

1912. *Phyllodactylus abrupteseriatus* WERNER, Jahrb. Hamburg Wiss. Anst., Beiheft 2: Mitt. Naturh. Mus. Hamburg, vol. 30, p. 4 (type locality, "wahrscheinlich Brasilien").

This species was described from a specimen which was thought to have come from Brazil, but two examples from Ecuador in the collection of the United States National Museum, No. 14053, secured on December 18, 1884, by Dr. William H. Jones, show the twelve longitudinal rows of enlarged dorsal tubercules, the third and sixth (outer) on each side much shortened, attributed to this form. *P. abrupteseriatus*, like *P. guayaquilensis*, is very closely related to *P. tuberculosus*. All three of these described forms apparently occur in the same general range in Ecuador and possess the same general colorational and scutellational features, except in regard to the arrangement of the dorsal tubercules. Morphologically, *abrupteseriatus* and *guayaquilensis* are more closely related than either of these and *tuberculosus*, for the former lizards possess twelve longitudinal rows of enlarged dorsal tubercules, some of which are shortened, whereas the latter possesses fourteen rows, more of which are full-sized.

PHYLLODACTYLUS BAESSLERI Werner

1900. *Phyllodactylus baessleri* WERNER, Abhandl. Ber. Zool. Anthropol.-Ethn. Mus. Dresden, vol. 9, no. 2, p. 2 (type locality, Chanchamayo, Peru).

One of these lizards, No. 38569, collected at Las Vocas landing, near Capon, region of Tumbe, Peru, by R. E. Coker, has 12 longitudinal rows of enlarged dorsal tubercules, the lower on each side being much shortened, however. In coloration and general appearance the species closely resembles *P. tuberculosus* and *P. magister*.

PHYLLODACTYLUS BAURII Garman

1892. *Phyllodactylus baurii* GARMAN, Bull. Essex Inst., vol. 24, p. 10 (type locality, Las Cuevas, Charles Island, Galapagos Archipelago).

Charles Island, Galapagos Archipelago.—One specimen, No. 14925, collected on April 8, 1888, by the United States Fish Commission steamer *Albatross.*

Hood Island, Galapagos Archipelago.—One specimen, No. 15019, collected on April 7, 1888, by the United States Fish Commission steamer *Albatross.*

PHYLLODACTYLUS GALAPAGOENSIS Peters

1869. *Phyllodactylus galapagoensis* PETERS, Monatsber. Berlin Akad. Wiss., p. 720 (type locality, Galapagos Islands).

1912. *Phyllodactylus galapagoensis daphnensis* VAN DENBURGH, Proc. Calif. Acad. Sci., ser. 4, vol. 1, p. 425 (type locality, Daphne Island, Galapagos Archipelago).

A *topotype* of *daphnensis* from Daphne Island (U.S.N.M. No. 78394, June 23, 1929, G. Pinchot, collector) shows more tubercules on the neck than the single representative of *galapagoensis* in the American Museum (No. 20524, from Albemarle Island). Since a further comparison of the two individuals reveals no differences that are likely to be constant it becomes necessary to regard *daphnensis* as a synonym of *galapagoensis.*

PHYLLODACTYLUS GERRHOPYGUS (Wiegmann)

1835. *Diplodactylus gerrhopygus* WIEGMANN, Nova Acta Acad. Caes. Leop.-Carol., vol. 17, pt. 1, p. 242, pl. 18, fig. 3 (type locality, Chile).

1885. *Phyllodactylus gerrhopygus* BOULENGER, Cat. Liz. Brit. Mus., vol. 1, p. 95.

Peru.—One specimen, No. 38570, obtained on San Gallan Island by R. E. Coker on June 27, 1907.

PHYLLODACTYLUS INAEQUALIS Cope

1876. *Phyllodactylus inaequalis* COPE, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 174, (type locality, Pacasmayo, Peru).

Peru.—One specimen, No. 17542, recorded as having been secured on San Lorenzo Island by Dr. H. E. Ames in 1876. Locality data somewhat doubtful.

PHYLLODACTYLUS LEEI Cope

1889. *Phyllodactylus leei* COPE, Proc. U. S. Nat. Mus., vol. 12, p. 145 (type locality, Chatham Island, Galapagos Archipelago).

Chatham Island, Galapagos Archipelago.—One specimen, No. 14957, the *type*, secured on April 4, 1888, by the United States Fish Commission steamer *Albatross.*

PHYLLODACTYLUS MAGISTER Noble

1924. *Phyllodactylus magister* NOBLE, Occas. Pap. Boston Soc. Nat. Hist., vol. 5, p. 110 (type locality, Perico, Peru).

This species is very closely related to *P. tuberculosus*.

Peru.—Five *paratypes*, Nos. 75946-50, collected by G. K. Noble at Bellavista.

PHYLLODACTYLUS MICROPHYLLUS Cope

1876. *Phyllodactylus microphyllus* COPE, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 175 (type locality, Valley of Jequetepeque, Peru).

Peru.—Six specimens, No. 75390, taken at Cruz de Hueso, Lima, on May 13, 1928, by R. C. Shannon, Nos. 38571-74, secured at Lobos de Apura on December 3, 1907, by R. E. Coker, and No. 17541, said to be from San Lorenzo Island by Dr. H. E. Ames. The locality data of No. 17541 are uncertain.

PHYLLODACTYLUS PULCHER Gray

1830. *Phyllodactylus pulcher* GRAY, Spicil. Zool., vol. 1, p. 3, pl. 3, fig. 1 (type locality, tropical America).—RUTHVEN, Occas. Pap. Mus. Zool. Univ. Michigan, no. 178, 1926, p. 1.

1887. *Phyllodactylus martini* VAN LIDTH DE JEUDE, Notes Leyden, Mus., vol. 9, p. 130 (type locality, Curaçao).

Curaçao, Dutch Leeward Islands.—One specimen, No. 64172, collected by T. Gaerste.

PHYLLODACTYLUS TUBERCULOSUS Wiegmann

1835. *Phyllodactylus tuberculosus* WIEGMANN, Nova Acta Acad. Caes. Leop.-Carol., vol. 17, pt. 1, p. 241, pl. 18, fig. 2 (type locality, California).

Specimens of this form from the Galapagos Islands and Ecuador, when compared, show much resemblance to each other.

Chatham Island, Galapagos Archipelago.—Two specimens, Nos. 14945 and 14956, collected on April 4, 1888 by the United States Fish Commission steamer *Albatross*.

Ecuador.—Two specimens, No. 12354, from Guayaquil.

Genus PSEUDOGONATODES Ruthven

PSEUDOGONATODES BARBOURI (Noble)

1921. *Lepidoblepharis barbouri* NOBLE, Ann. New York Acad. Sci., vol. 29, p. 133 (type locality, Perico, Peru).

1926. *Pseudogonatodes barbouri* PARKER, Ann. Mag. Nat. Hist., ser. 9, vol. 17, p. 298.

Peru.—Seven *paratypes*, Nos. 75952–54, collected at Bellavista by G. K. Noble, and Nos. 64035–38, secured at Perico by H. G. Raven.

Genus THECADACTYLUS Oken

THECADACTYLUS RAPICAUDUS (Houttuyn)

1782. *Gekko rapicauda* HOUTTUYN, Verh. Zeeuwsch. Genoot. Wet. Vlissingen. vol. 9, p. 323 (type locality, American Islands).

1845. *Thecadactylus rapicaudus* GRAY, Cat. Liz. Brit. Mus., p. 146.—BOULENGER, Cat. Liz. Brit. Mus., vol. 1, 1885, p. 3.

The specimens of this species in the collection of the United States National Museum may be listed as follows:

No.	Locality	Date	Collector
8296	South America		
27790	La Guaira, Venezuela	July 5, 1900	M. W. Lyon and W. Robinson.
72759	Puerto la Cruz, Venezuela		H. Pittier.
13858	Trinidad	Feb. 2, 1884	U. S. Fish Commission steamer Albatross.
5766	Trinidad		Thomas.

Family IGUANIDAE

Genus AMBLYRHYNCHUS Bell

AMBLYRHYNCHUS CRISTATUS Bell

1825. *Amblyrhynchus cristatus* BELL, Zool. Journ., vol. 2, p. 206 (type locality, "Mexico," no doubt in error).

Galapagos Archipelago.—One specimen, No. 37010, from the United States Fish Commission steamer *Albatross*, taken in 1891.

Abingdon Island, Galapagos Archipelago.—One specimen, No. 15902, from the United States Fish Commission steamer *Albatross*, taken on April 16, 1886.

Daphne Island, Galapagos Archipelago.—One specimen, No. 78393, collected by G. Pinchot on June 23, 1929.

Duncan Island, Galapagos Archipelago.—Six specimens, Nos. 19962–7 from the United States Fish Commission steamer *Albatross*, taken in 1891.

James Island, Galapagos Archipelago.—One specimen, No. 15187, from the United States Fish Commission steamer *Albatross*, taken on April 13, 1888.

Tower Island, Galapagos Archipelago.—Three Specimens, No. 65921, collected on May 17, 1923, by J. F. Mitchell, and Nos. 78386–87, taken at Darwin Bay by G. Pinchot on June 16, 1929.

Genus ANISOLEPIS Boulenger

This genus is very closely related to *Aptycholaemus* Boulenger (1891). Relationship between the two genera should be sought through an examination of specimens of *Anisolepis grillii* and *Aptycholaemus longicauda* as well as in other ways.

ANISOLEPIS UNDULATUS (Wiegmann)

1834. *Lacmanctus undulatus* WIEGMANN, Herpetologia Mexicana, p. 46 (type locality, Brazil).
1834. *Lacmanctus obtusirostris* WIEGMANN, Herpetologia Mexicana, p. 46 (type locality, Brazil).
1843. *Lacmanctus* (*Urostrophus*) *undulatus* FITZINGER, Syst. Reptilium, p. 62.
1845. *Ecphymotes undulatus* GRAY, Cat. Liz. Brit. Mus., p. 185.
1845. *Ecphymotes obtusirostris* GRAY, Cat. Liz. Brit. Mus., p. 185.
1885. *Enyalius undulatus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 121.
1885. *Anisolepis iheringii* BOULENGER, Ann. Mag. Nat. Hist., ser. 5, vol. 16, p. 85 (type locality, San Lorenzo, Rio Grande do Sul, southern Brazil); Cat. Liz. Brit. Mus., vol. 2, 1885, p. 122.
1895. *Anisolepis bruchi* KOSLOWSKY, Revista Mus. La Plata, vol. 6, p. 417 (type locality, Punta Lara, Argentina).

The synonymy of this well marked species is after Werner (1896), p. 471), who has given a synoptic treatment to the genus *Anisolepis*. It is listed here only to draw further attention to the great change in nomenclature since the appearance of Boulenger's Catalogue in 1885.

Uruguay.—Three specimens, Nos. 65545–47, collected at Paysandu by F. Felippone.

Genus ANOLIS Daudin

ANOLIS AENEUS Gray

1840. *Anolis aeneus* GRAY, Ann. Nat. Hist., vol. 5, p. 114 (type locality, unknown).—RUTHVEN, Occas. Pap. Mus. Zool. Univ. Michigan, no. 143, 1923, p. 6 (Trinidad).
1863. *Anolis trinitatis* REINHARDT and LÜTKEN, Vidensk. Meddel. Nat. Foren. Kjöbenhavn for 1862, p. 269 (type locality, Trinidad).—BARBOUR, Mem. Mus. Comp. Zoöl., vol. 44, no. 2, 1914, p. 281.
1885. *Anolis alligator* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 31, (part).

Tobago.—Thirty-one specimens, Nos. 10102–12, 10114–15, 10117–20 and 10123–36, collected in 1878 by F. A. Ober.

ANOLIS AGASSIZI Stejneger

1900. *Anolis agassizi* STEJNEGER, Bull. Mus. Comp. Zoöl., vol. 36, no. 6, p. 161, pl. 1 (type locality, Malpelo Island, Pacific Ocean, off Colombia).

The collection of the United States National Museum contains the *type* of this species, No. 22101, and *two paratypes*, Nos. 22103–104, all collected by Charles H. Townsend, on Malpelo Island on March 5, 1891.

ANOLIS APOLLINARIS Boulenger

1919. *Anolis apollinaris* BOULENGER, Proc. Zool. Soc. London, p. 79 (type locality, Bogotá, Colombia).

Ecuador.—Two specimens, Nos. 65493–94, collected at Macas, Province of El Oriente by M. Madira.

ANOLIS CHRYSOLEPIS Duméril and Bibron

1837. *Anolis chrysolepis* DUMÉRIL and BIBRON, Erp. Gén., vol. 4, p. 94 (type locality, Guiana).

Trinidad.—Two specimens, No. 20414, collected by H. Caracciola, and No. 17729, collected by G. T. Wayman in 1891.

Venezuela.—Four specimens, Nos. 22522 and 22524–25 taken on June 23, 1895, and 27818, taken on July 12, 1900, all collected at La Guaira by W. Robinson.

ANOLIS FUSCO-AURATUS D'Orbigny

1837. *Anolis fusco-auratus* D'ORBIGNY, in DUMÉRIL and BIBRON, Erp. Gén., vol. 4, p. 110 (type locality, Chile).

Brazil.—One specimen, No. 28951, secured at Hyutaihan, Lower Amazonia, by J. B. Steere.

ANOLIS JACARE Boulenger

1903. *Anolis jacare* BOULENGER, Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 482 (type locality, Merida, Venezuela).

Colombia.—One specimen, No. 72745, collected at Tapatá, Dept. Norte de Santander, by E. P. Killip in March, 1927.

ANOLIS LATIFRONS Berthold

1847. *Anolis latifrons* BERTHOLD, Abhandl. Ges. Göttingen, vol. 3, p. 6 (type locality, Province Popayan, Colombia).

Colombia.—One specimen, No. 4318, secured at Turbo, in the Choco region, by N. Michler.

ANOLIS LINEATUS Daudin

1802. *Anolis lineatus* DAUDIN, Hist. Nat. Reptiles, vol. 4, p. 66 (type locality, South America).

Curaçao, Dutch Leeward Islands.—One specimen, No. 63240, taken by Thomas Gaerste.

Genus APTYCHOLAEMUS Boulenger

The lizards of this genus have the general appearance and size of *Anisolepis*, but they do not have the well developed collar fold of that genus.

APTYCHOLAEMUS LONGICAUDA Boulenger

1891. *Aptycholaemus longicauda* BOULENGER, Ann. Mag. Nat. Hist., ser. 6, vol. 8, p. 85 (type locality, Riacho del Oro, Argentina).

1895. *Anisolepis argentinus* KOSLOWSKY, Revista Mus. La Plata, vol. 6, p. 419 (type locality, Province of Buenos Aires, Argentina).

This lizard is easily distinguished from *Anisolepis undulatus* by the obsolescence or complete absence of the lateral light band or stripes, as well as by the generic character.

Argentina.—One specimen, No. 73504, collected by the Breyer brothers.

Berg (1898, p. 3) is followed here in regarding *Anisolepis argentinus* Koslowsky (1895) as a synonym of *Aptycholaemus longicauda* Boulenger (1891).

Genus BASILISCUS Laurenti

BASILISCUS BASILISCUS (Linnaeus)

1758. *Lacerta basiliscus* LINNAEUS, Syst. Nat., ed. 10, vol. 1, p. 206 (type locality, South America).

1768. *Basiliscus americanus* LAURENTI, Synops. Reptil., p. 50 (type locality, South America).—BOULENGER, Cat. Liz. Brit. Mus., vol. 2, 1885, p. 108.

1926. *Basiliscus basiliscus* PARKER, Ann. Mag. Nat. Hist., ser. 9, vol. 17, p. 550 (Gorgona Island, Gulf of Panama).

Colombia.—Two specimens, No. 32276 from Truando, and No. 4322 from Turbo, both secured by A. Schott. These examples were taken near the Panama-Colombia border.

BASILISCUS GALERITUS Duméril

1851. *Basiliscus galeritus* DUMÉRIL, Cat. Méth. Rept., p. 61 (type locality, "N.-Grenade," Colombia).

Ecuador.—One specimen, No. 62786 from Guayaquil, collected by F. W. Goding.

Genus ENYALIOIDES Boulenger

ENYALIOIDES HETEROLEPIS (Bocourt)

1874. *Enyalius heterolepis* BOCOURT, Ann. Sci. Nat., ser. 5, vol. 19, art. 4, p. 1 (type locality, Veragua, Panama).

1885. *Enyalioides heterolepis* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 114.

Ecuador.—Two specimens, No. 22449, and No. 20612, collected on January 9, 1893, in the Santiago River Valley, both taken by Mark B. Kerr.

ENYALIOIDES LATICEPS LATICEPS (Guichenot)

1855. *Enyalius laticeps* GUICHENOT, in CASTELNAU, Exp. l'Amer. du Sud, Zool., Reptiles, p. 20 (type locality, Fonteboa, upper Amazon, Brazil).

Ecuador.—One specimen, No. 60521, from San Rafael, Guayas Province, collected by James B. Rorer.

ENYALIOIDES MICROLEPIS (O'Shaughnessy)

1881. *Enyalius microlepis* O'Shaugnessy, Proc. Zool. Soc. London, p. 238 (type locality, Sarayacu, Ecuador).

1885. *Enyalioides microlepis* Boulenger, Cat. Liz. Brit. Mus., vol. 2, p. 115.

Ecuador.—Two specimens, Nos. 22448 and 22450, collected by Mark B. Kerr.

Genus ENYALIUS Wagler

ENYALIUS IHERINGII Boulenger

1885. *Enyalius iheringii* Boulenger, Ann. Mag. Nat. Hist., ser. 5, vol. 15, p. 192 (type locality, Rio Grande do Sul, Brazil).

Three specimens, No. 58423 from southern Brazil (Hurter collection), and Nos. 40214–15 from Santa Catherina, taken by W. Ehrdhardt in January, 1910, "from the primeval forests bordering the Rio Humboldt, about 120 kilometers from the sea-coast in the Serra do Mar." Rio Humboldt is an affluent of Rio Itapocu.

Genus IGUANA Gronovius

IGUANA IGUANA (Linnaeus)

1758. *Lacerta iguana* Linnaeus, Syst. Nat., ed. 10, vol. 1, p. 206 (type locality, America).

1768. *Iguana tuberculata* Laurenti, Synops. Reptilium, p. 49 (type locality, unknown).—Boulenger, Cat. Liz. Brit. Mus., vol. 2, 1885, p. 189.

1900. *Iguana iguana* Andersson, Bihang Svenska Vet.-Akad. Handl., vol. 26, sect. 4, No. 1, p. 10.

The specimens of *Iguana iguana* in the collection of the United States National Museum may be listed as follows:

No.	Locality	Date	Collector
28940–43	Lower Amazonia, Brazil		J. B. Steere.
11413	Demerara, British Guiana.	1881	Philip Figyelmesy.
8542	Surinam		C. J. Hering.
12628	do	July 12, 1882	Do.
11314	do	July 8, 1879	Do.
13869	Sabanilla, New Granada, Colombia.		Albatross.
12202, 12265	South America		
12295	do		Captain Page.
64597–98	do		Louis Ruhe.
5790	Trinidad		T. Gill.
17720	do	Aug. 20, 1891	Roger Wells, jr.
56767	Venezuela	1906	Hurter Collection.
22516	La Guaira, Venezuela	June 25, 1895	W. Robinson.
22517	do	June 22, 1895	Do.
27817	do	July 10, 1900	Do.
22518	Margarita Island, Venezuela.	July 7, 1895	Do.
27827–28	Rio Chico, Venezuela		L. Goldschmidt.

Genus LEIOCEPHALUS Gray

LEIOCEPHALUS ARENARIUS (Tschudi)[2]

1845. *Steironotus arenarius* Tschudi, Fauna Peruana, Herpet., p. 25 (type locality "Huacho, nördlich von Lima", Peru).
1901. *Liocephalus rhodogaster* Boulenger, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 547 (type locality "Merced, Perené River," central Peru).
1907. *Liocephalus arenarius* Roux, Revue Suisse Zool., vol. 15, p. 300.
1921. *Leiocephalus arenarius* Barbour and Noble, Proc. U. S. Nat. Mus., vol. 58, p. 612.
1921. *Leiocephalus ervingi* Barbour and Noble, Proc. U. S. Nat. Mus., vol. 58, p. 612 (not *Stenocercus ervingi* Stejneger, 1913).

In describing this lizard as *rhodogaster*, Boulenger (1901) considered it to be "most nearly related to *L. erythrogaster*" of Colombia, although the nearest geographical representative of its genetic section of the genus appears to be *L. ornatus ornatus* of Ecuador. In fact it seems but slightly differentiated from the latter form, having its reduced head plates and small dorsal scutes as well.

Roux (1907) is followed in finding *rhodogaster* to be synonymous with *arenarius*, but it is apparent that Barbour and Noble (1921) were not correct in regarding *L. lineogularis* Werner (1901) as another synonym.

Stenocercus ervingi was described from southern Peru by Stejneger (1913), but was later (1921) regarded as *Leiocephalus ervingi* by Barbour and Noble, who, without examining the type, wrote that "This specimen was only 84 mm. in total length, and the generic characters were difficult or impossible to discern. We have before us a single adult (U.S.N.M. No. 60742), which we believe to be a *Leiocephalus*, owing to the presence of abdominal ribs and of general *Leiocephalus* squamation. It is beyond doubt the adult of Stejneger's species." An examination of all of the specimens concerned, including the type of *ervingi* and those younger examples referred to *Leiocephalus arenarius* by Barbour and Noble, shows Stejneger's species to be correctly diagnosed, and also shows that the *Leiocephalus ervingi* and the *Leiocephalus arenarius* of Barbour and Noble are identical.

Peru.—Five specimens, Nos. 60811 taken at Toranton at 8,500 feet elevation on May 1, 1915, and 60705–706, from Chospiyoc on the Huarocondo River taken at 10,000 feet elevation on April 20, 1915, No. 60742 from Machu Picchu on Oct. 30, 1915, at 8,000 feet, and No. 60810 from Ollantaytambo on May 15, 1915, this one secured by O. F. Cook, the first four secured by Edmund Heller, for the Yale-Peruvian Expedition.

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[2] This species should not be confused with "*Liocephalus arenarius*" Barbour (1916), a form described from Bastion Cay, Turks Islands, W. I., and later renamed *Leiocephalus psammodromus* Barbour (1920, p. 73).

LEIOCEPHALUS CADUCUS (Cope)

1862. *Scartiscus caducus* COPE, Proc. Acad. Nat. Sci. Philadelphia, p. 182 (type locality, Paraguay).—BOULENGER, Cat. Liz. Brit. Mus., vol. 2, 1885, p. 127.

1890. *Liocephalus bolivianus* BOULENGER, Proc. Zool. Soc. London, p. 82 (type locality, Bolivia).—PERACCA, Boll. Mus. Zool. Univ. Torino, vol. 12, No. 274, 1897, p. 5.

1894. *Liocephalus caducus* BOULENGER, Ann. Mag. Nat. Hist., ser. 6, vol. 13, p. 342.

Boulenger (1894) is followed in regarding the genus *Scartiscus* as identical with *Leiocephalus*, and also in considering his *Liocephalus bolivianus* as a synonym of *Leiocephalus caducus*, the type species of *Scartiscus*.

An examination of the type of this species (U.S.N.M. No. 5852, collected in Paraguay by Captain Page) shows that the caudals have indistinct verticils of the same general type as those found in *Leiocephalus*. Posteriorly an indication of a weak lateral crest is present on each side. Still less of an indication of this crest is found in the related form, *L. lineogularis*, as shown by the examination of the topotype in the collection of the American Museum of Natural History (No. 23154).

Besides the *type*, the United States National Museum has a topotype from Paraguay, No. 69874, collected in the Chaco by F. Felippone.

LEIOCEPHALUS IRIDESCENS IRIDESCENS (Günther)

1859. *Liocephalus iridescens* GÜNTHER, Proc. Zool. Soc. London, p. 409 (type locality, Andes of western Ecuador).

Ecuador.—Five specimens, No. 14058, taken on December 18, 1884, by W. H. Jones, Nos. 12275 (2 specimens) and 12281 from Guayaquil, and No. 61755, collected by J. N. Rose at Huigra in 1918.

LEIOCEPHALUS ORNATUS ORNATUS (Gray)

1845. *Leiocephalus ornatus* GRAY, Cat. Liz. Brit. Mus., p. 219 (type locality, Guayaquil, Tropical America).

Ecuador.—One specimen, No. 32859, from the Alausi Valley, 8,500 feet elevation, secured by S. A. Davis.

LEIOCEPHALUS ORNATUS TRACHYCEPHALUS (Duméril)

1851. *Holotropis trachycephalus* A. DUMÉRIL, Cat. Méth. Coll. Reptiles, Paris, p. 70 (type locality, Nouvelle Grenade, et en par-particulier Santa-Fé de Bogotá).

1885. *Liocephalus trachycephalus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 169.

Colombia.—One *topotype*, No. 75958, from Bogotá, collected by Hno. Apolinar Maria in 1920.

Genus LEIOSAURUS[3] Duméril et Bibron

1837. *Leiosaurus* DUMÉRIL and BIBRON, Erp. Gén., vol. 4, p. 241 (type species, *L. bellii* Duméril et Bibron).

1843. *Pristidactylus* FITZINGER, Syst. Rept., p. 16 (type species, *Leiosaurus fasciatus* D'Orbigny).

1843. *Diplolaemus* BELL, Zool. "Beagle", Reptiles, p. 19 (type species, *D. darwinii* Bell).

1845. *Ptenodactylus* GRAY, Cat. Liz. Brit. Mus., p. 224 (type species, *Leiosaurus fasciatus* D'Orbigny).

The lizards of this genus are in a state of great systematic confusion and a careful study of the species and subspecies is much to be desired. The generic synonymy indicated above, with the exception of the last entry, is after Koslowsky (1896, p. 167).

Aperopristis Peracca, as described, differs little from *Leiosaurus* Duméril and Bibron, the differences exhibited by the type species, *A. paronae*, being slight and seemingly of specific rather than of generic nature. Therefore the two genera may ultimately be considered as one.

LEIOSAURUS BELLII Duméril and Bibron

1837. *Leiosaurus bellii* DUMÉRIL and BIBRON, Erp. Gén., vol. 4, p. 242 (type locality, "Mexique", no doubt in error).

Like *Leiosaurus catamarcensis*, this species has a row of isolated dark markings along the middorsal line, but it differs, apparently, in having these markings more elongate or pointed before and behind, in possessing slightly smaller dorsal granules, and in the absence of a more or less developed dorsal denticulation. The two forms are obviously very closely related and will probably be found to be subspecifically allied by subsequent workers.

Argentina.—Two specimens from Chubut Province, Patagonia, Nos. 22737-38, received from Museo de la Plata.

LEIOSAURUS BIBRONII (Bell)

1843. *Diplolaemus bibronii* BELL, Zool. "Beagle", Reptiles, p. 21, pl. 11 (type locality, Port Desire, Patagonia).

1885. *Diplolaemus darwinii* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 126, (part: types) (not of Bell).

Stejneger (1909, pp. 221-223) has indicated that *L. bibronii* and *L. darwinii* are separable on the character of the scutellation and coloration, the former having larger scales on the head and a different color pattern.

Argentina.—Eight specimens, Nos. 36939–41 and 36944–48, collected in 1898 by J. B. Hatcher in Patagonia, "about margin of small salt lakes."

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[3] The generic name "*Leiosaurus*" Duméril and Bibron was emended by Boulenger (1885, p. 124) to read "*Liosaurus.*" In accordance with article 20 of the International Rules of Zoological Nomenclature the original orthography is retained.

LEIOSAURUS CATAMARCENSIS (Koslowsky)

1898. *Liosaurus catamarcensis* KOSLOWSKY, Revista Mus. La Plata, vol. 8, p. 169 (type locality, Provincia de Catamarca, Argentina).
1898. *Liolaemus catamarcensis* KOSLOWSKY, Revista Mus. La Plata, vol. 8, pl. 1, opposite p. 200 (*lapsus calami*!).
1922. *Apcropristis catamarcensis* MÜLLER, Senckenbergiana, vol. 4, p. 159.

As indicated above, this form is closely related to *L. bellii*. It is also allied to *Apcropristis paronae* (Peracca), the type species of the supposed genus *Apcropristis*, as pointed out recently by Müller (1922).

Argentina.—Three specimens, No. 63952, collected on November 29, 1920, by Alexander Wetmore at General Roca, Rio Negro, No. 52600, taken in March, 1914, at Mendoza by Dr. Carlos S. Reed, and No. 63953, secured on December 24, 1920, at Victorica, Pampa, by Alexander Wetmore.

LEIOSAURUS DARWINII (Bell)

1843. *Diplolaemus darwinii* BELL, Zool. "Beagle," Reptiles, p. 20 (type locality, Port Desire, Patagonia).
1898. *Liosaurus darwini* KOSLOWSKI, Revista Mus. La Plata, vol. 8, p. 169.

This species and *L. bibronii* differ from *L. bellii* and *L. catamarcensis* in not having a distinctly isolated series of dark markings along the middorsal line. The dark markings are either lateral or transverse instead.

Argentina.—Eight specimens, Nos. 22739–40, from Santa Cruz, received from Museo de la Plata; No. 34701 from Neuquén Province, said to be "common on the sands of Cordilleras" collected on November 12, 1903, by J. W. Titcomb, and Nos. 36949–53, taken in 1898 by J. B. Hatcher in Patagonia.

Genus LIOLAEMUS Wiegmann

LIOLAEMUS BIBRONII (Bell)

1845. *Leiolaemus bibronii* BELL, Zool. "Beagle," Rept., p. 6 (type locality, Port Desire, Argentina).
1845. *Leiolaemus bellii* GRAY, Cat. Liz. Brit. Mus., p. 212 (type locality, Chile).
1845. *Leiolaemus lineatus* GRAY, Cat. Liz. Brit. Mus., p. 213 (type locality, Chile).

Argentina.—Three specimens, No. 73653, Lago Gutierrez, Rio Negro Territory, collected on November 3, 1926, by Dr. and Mrs. R. C. Shannon, No. 34703, collected by J. W. Titcomb on December 5, 1903, and No. 36932, Patagonia, collected by J. B. Hatcher in 1898.

LIOLAEMUS CHILIENSIS (Lesson)

1831. *Calotes chiliensis* LESSON, in Duperry, Voy. "Coquille," Zool., vol. 2, pt. 1, p. 36 (type locality, Talachuano, Province de la Concepcion, Chile).
1885. *Liolaemus chilensis* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 141.

Chile.—Two specimens, No. 15128, taken on February 20, 1888, at Tome by the United States Fish Commission steamer *Albatross*, and No. 64122, secured in February, 1921, at Valparaiso by Dr. Edwyn P. Reed.

LIOLAEMUS CYANOGASTER (Duméril and Bibron)

1837. *Proctotretus cyanogaster* DUMÉRIL and BIBRON, Erp. Gén., vol. 4, p. 273 (type locality, Chile).
1885. *Liolaemus cyanogaster* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 145.

Chile.—One specimen, No. 75959, from Cohuelue, southern part, collected by Dr. Thomas Barbour.

LIOLAEMUS DARWINII (Bell)

1843. *Proctotretus darwinii* BELL, Zool. "Beagle," Rept., p. 14 (type locality, Bahia Blanca, northern Patagonia).
1885. *Liolaemus darwinii* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 155.

Argentina.—Four specimens, Nos. 31093–94 from the U. S. Exploring Expedition, No. 38122 from Desaguadero, San Luis Province, collected by Juan Tremoleros, and No. 64131, from Potrerillos, Mendoza, collected by Alexander Wetmore, March 18, 1921.

In some of the above examples a white middorsal line appears, and in others it is obscure or absent.

LIOLAEMUS ELONGATUS Koslowsky

1896. *Liolaemus elongatus* KOSLOWSKY, Rev. Mus. La Plata, vol. 7, p. 450 (type locality, Territory of Chubut, Argentina).

Four large representatives of this form, U. S. Nat. Mus. Nos. 63954–7, taken by Alexander Wetmore on December 9, 1920, at Zalapa, Gobernacion de Neuquen, Argentina, indicate that it may be related to *L. multiformis simonsii*. The dorsal scales are very small, much smaller than the lateral and ventral scutes, and distinctly, though not strongly, keeled. Stripes are not present on the body and, with the exception of a more or less pronounced cross-barring on the tail, there is little evidence of a longitudinal arrangement in the dorsal markings. The median dorsal area of the back is unicolor, or nearly so, and dark brown in shade, but the lateral region is light brown or gray with white spots. The flanks and under surfaces are tinged with blue green, and are covered with more or less indistinct slate or brownish flecks.

LIOLAEMUS FITZINGERII (Duméril and Bibron)

1837. *Proctotretus fitzingerii* DUMÉRIL and BIBRON, Erp. Gén., vol. 4, p. 286 (type locality, Chile).
1885. *Liolaemus fitzingeri* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 150.

Argentina.—Nine specimens, Nos. 36933–38 collected in 1898 by J. B. Hatcher, in Patagonia, No. 38937 from Valle de los Horcones

collected by Dr. Thomas Barbour, and Nos. 22741 from Catamarca and 22762 from Chubut, the last two received from Museo de la Plata.

LIOLAEMUS HATCHERI Stejneger

1909. *Liolaemus hatcheri* STEJNEGER, Rep. Princeton Univ. Exp. Patagonia, vol. 3, pt. 2, p. 218 (type locality, southern Patagonia, Territory of Santa Cruz).

Argentina.—Six specimens, No. 36912, the *type*, and Nos. 36907–11, *paratypes*, collected by J. B. Hatcher in Patagonia in 1898.

LIOLAEMUS KINGII (Bell)

1843. *Proctotretus kingii* BELL, Zool. "Beagle," Reptiles, p. 13, (type locality, Port Desire in Patagonia).

1885. *Liolaemus kingii* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 149.

Argentina.—Twenty specimens from Patagonia, No. 34702, taken by J. W. Titcomb at 1,000 feet elevation in the Mountains of Neuquen on November 10, 1903, and Nos. 36913–31, secured by J. B. Hatcher in 1898.

LIOLAEMUS LEMNISCATUS Gravenhorst

1838. *Liolaemus lemniscatus* GRAVENHORST, Nova Acta Caes. Acad. Leop.-Carol., vol. 18, pt. 2, p. 731 (type locality, Valparaiso).—BOULENGER, Cat. Liz. Brit. Mus., vol. 2, 1885, p. 143.

1845. *Liolaemus elegans* TSCHUDI, Fauna Peruana, Herpet., p. 33 (type locality, Chancay, Peru).

1885. *Liolaemus fuscus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 144 (type locality, Valparaiso, Chile).

Roux (1907, p. 297) has compared the types of *Liolaemus elegans* Tschudi with examples of *L. lemniscatus* and has considered them to be identical.

South America.—Two specimens, Nos. 11466 and 9822.

Chile.—Five specimens, No. 62257, obtained at Calama by C. G. Abbott, and No. 5525 (four specimens) taken at Santiago by Lieut. J. M. Gilliss.

Peru.—One specimen, No. 52211, from Oroya, collected in the high Andes at 12,000 feet elevation, by J. N. Rose. This example, having about 50 scale rows around the body, is typical of the *Liolaemus fuscus* of Boulenger (1885), and apparently of *Liolaemus elegans* Tschudi (1845) as well.

LIOLAEMUS LINEOMACULATUS Boulenger

1885. *Liolaemus lineomaculatus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 149 (type locality, Patagonia).

Argentina.—Seventeen specimens, No. 22765 from Chubut, Nos. 52963–64 from Mendoza, collected in 1914 by R. Sanzin, and Nos.

36893–905 from Patagonia and 36906 from "The Salinas," near mouth of Rio Santa Cruz, the latter series collected by J. B. Hatcher in 1898.

LIOLAEMUS MULTIFORMIS MULTIFORMIS (Cope)

1876. *Proctotretus multiformis* COPE, Journ. Acad. Nat. Sci. Philadelphia, p. 173 (type locality, Lake of Titicaca, Peru).
1885. *Liolaemus multiformis* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 153.
1901. *Liolaemus annectens* BOULENGER, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 546 (type locality, "Cayllome and Sumbay," Andes of Peru).—STEJNEGER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 546.

Peru.—Six specimens, No. 75960, taken at Vincocayo at 14,500 feet elevation by Samuel Garman, and Nos. 49544–48, collected between Cotahuasi and Chuquibamba at 15,500 feet elevation by the Yale-Peruvian Expedition.

LIOLAEMUS NIGROMACULATUS (Wiegmann)

1834. *Tropidurus nigromaculatus* WIEGMANN, in MEYEN, Reise um die Erde 1830–1832), vol. 1, p. 206 (*nomen nudem*); Nova Acta Acad. Caes. Leop.-Carol., vol. 17, 1835, pt. 1, p. 229 (type locality, Chile).
1845. *Leiolaemus nigromaculatus* GRAY, Cat. Liz. Brit. Mus., p. 213.

Chile.—Three specimens, No. 5692, secured at Valparaiso by members of the United States exploring expedition, and Nos. 38934–35, taken at Caldera by Thomas Barbour.

Peru.—One specimen, No. 12199, collected by C. H. Raymond.

LIOLAEMUS NITIDUS (Wiegmann)

1834. *Tropidurus nitidus* WIEGMANN, in MEYEN, Reise um die Erde (1830–1832), vol. 1, p. 206 (*nomen nudem*); Nova Acta Acad. Caes. Leop.-Carol., vol. 17, 1835, pt. 1, 234 (type locality, Chile).
1885. *Liolaemus nitidus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 140.

Chile.—Three specimens, No. 5869, obtained at Valparaiso by the United States exploring expedition, and Nos. 64123–24, collected at Valparaiso by Dr. Edwyn P. Reed in February, 1921.

LIOLAEMUS PICTUS PICTUS (Duméril and Bibron)

1837. *Proctotretus pictus* DUMÉRIL and BIBRON, Erp. Gén., vol. 4, p. 276 (type locality, Chile).
1885. *Liolaemus pictus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 151.

Argentina.—One specimen, No. 73654, collected by Dr. and Mrs. R. C. Shannon on November 3, 1926, at Lago Gutierrez, Rio Negro Territory.

Chile.—One specimen, No. 58398, from the Hurter Collection.

LIOLAEMUS TENUIS (Duméril and Bibron)

1837. *Proctotretus tenuis*, Duméril and Bibron, Erp. Gén., vol. 4, p. 279 (type locality, Chile).

1885. *Liolaemus tenuis* Boulenger, Cat. Liz. Brit. Mus., vol. 2, p. 152.

Chile.—Twenty specimens, No. 15127, secured at Lota on February 17, 1888, by members of the United States Fish Commission Steamer *Albatross*, No. 5518 (18 specimens) taken at Santiago by Lieut. J. M. Gilliss, and No. 5652, from Valparaiso, collected on the United States exploring expedition to the Southern Hemisphere.

LIOLAEMUS WIEGMANNII (Duméril and Bibron)

1837. *Proctotretus wiegmannii* Duméril and Bibron, Erp. Gén., vol. 4, p. 284 (type locality, Chile).

1885. *Liolaemus wiegmanni* Boulenger, Cat. Liz. Brit. Mus., vol. 2, p. 156.

Argentina.—Four specimens, No. 52596, collected at Mendoza by Dr. Carlos S. Reed, and Nos. 63948–50, taken at Victorica, Pampa, by Alexander Wetmore during the month of December, 1920.

Paraguay.—One specimen, No. 12197, collected by Captain Page.

Uruguay.—Twenty-three specimens, Nos. 48609, 70477–81, and 73531–32, collected by F. Felippone, Nos. 65561, and 65564–65, secured by F. Felippone at Buceo, Montevideo, No. 65616, taken at Cape Polonia on December 6, 1922, by H. M. Smith, No. 65556, obtained at Carrasco in March, 1916, by F. Felippone, No. 65540, collected at Canelones by F. Felippone, Nos. 68037–38, collected at Malvin, Montevideo, by F. Felippone, Nos. 65566–74 and 73916, from Montevideo, collected by F. Felippone, and No. 38111, from Punta Carretas, near Montevideo, collected by J. Tremoleras on November 17, 1907.

Seven specimens with doubtful locality data are Nos. 17543–49, supposedly from San Lorenzo Island, Peru, collected by Dr. H. E. Ames.

Genus NOROPS Wagler

NOROPS AURATUS (Daudin)

1803. *Anolis auratus* Daudin, Hist. Nat. Reptiles, vol. 4, p. 89 (type locality, not indicated).

1845. *Norops auratus* Gray, Cat. Liz. Brit. Mus., p. 207.

Dutch Guiana.—One specimen, No. 13818, from Paramaribo, collected by C. J. Hering on March 18, 1884.

Genus PLICA Gray

SYNOPSIS OF THE SPECIES

1. Occipital plate about one-fourth as wide as the breadth of the head; a spiny, pouch-like projection present in the region a little posterior to the upper border of the tympanum 2

Occipital plate at least one-half as wide as the breadth of the head; no spiny, pouch-like projection in the region a little posterior to the upper border of the tympanum 3

2. Posterior tibial scales without prominent projecting spines; supraocular scales wider, band-like; caudal crest usually composed of low denticulations ..... **P. plica** (Linnaeus).
(Northern South America.)

Posterior tibial scales with prominent projecting spines; supraocular scales squarish or rounded, not band-like; caudal crest composed of a series of thin, moderately elevated serrations ..... **P. stejnegeri**, new species.
(Argentina.)

3. Occipital plate large, about half as wide as the head ..... **P. umbra** (Linnaeus).
(Northern South America.)

Occipital plate very large, "much broader than half the breadth of the head" ..... **P. tuberculatum** Andersson.
(Bolivia.)

PLICA PLICA (Linnaeus)

1758. *Lacerta plica* LINNAEUS, Syst. Nat., ed. 10, vol. 1, p. 208 (type locality, "in Indiis").
1885. *Uraniscodon plica* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 180.
1901. *Plica plica* STEJNEGER, Proc. U. S. Nat. Mus., vol. 24, p. 182.

Dutch Guiana.—One specimen, No. 11047, collected by C. J. Hering in Surinam.

Trinidad.—Two specimens, Nos. 17727–28, collected by G. T. Wayman in 1891.

Venezuela.—Two specimens, Nos. 27798–99, taken at La Guaira by M. W. Lyon and W. Robinson.

PLICA STEJNEGERI, new species

Diagnosis.—Head scales mostly small; supraoculars not band-like; occipital plate large, about one-fourth as broad as the breadth of the head; dorsal and caudal crest moderate, prominent, composed of thin serrations; dorsal and caudal scales imbricate and strongly keeled; posterior tibial scales strongly spinose; two complete and one incomplete gular folds; legs short and heavy. Dorsal ground color gray with brown spots and reticulations, the latter tending to form a series of obtuse chevrons on the back; throat and upper chest marbled with grayish but not black.

Habitat.—Argentina.

Type specimen.—U.S.N.M. Cat. No. 73505; Argentina; Breyer Bros., collectors.

Description of type specimen.—Head moderate, snout short; nostril latero-superior, separated from rostral; superciliary edge projecting, angular; upper head scales smooth or tubercular, but not distinctly keeled; two series of interorbitals; three to five enlarged supraoculars, these more or less squarish or rounded and not occupying over half of the supraocular region; parietals indistinct or

juxtaposed between the supraocular area and the occipital plate; occipital large, about one-fourth as broad as the breadth of the head; anterior border of tympanum with long projecting spines.

Neck only slightly constricted, strongly plicate and pouched inferiorly; two complete and one incomplete gular folds, the latter's halves distinct and continuous with a dorso-lateral fold on each side, but failing to meet medially; sides of neck with many tufts of small, erect, spinose scales.

Dorsal scales slightly larger than lateral scales; both dorsal and lateral scales moderate, strongly keeled, with sharp projecting posterior spines; dorsal crest moderate, serrations thin; dorso-lateral fold covered with many small, erect, spinose scales; a second more or less distinct fold on each side from axilla to groin; ventral scales about the same size as the largest dorsals but smaller than all of the anterior caudals, smooth; limbs covered by large, keeled, imbricate scales; infradigital lamellae distinctly keeled.

The adpressed hind limb does not reach beyond the tympanum.

Tail thick at its base, a little compressed, and with a moderate dorsal crest.

Grayish olive or greenish above, spotted and marbled with dark brown; the brown reticulations forming more or less distinct cross-bands on the back, tail and limbs; a collar of blackish or slaty hue; throat and upper chest shaded or reticulated with gray; other lower surfaces yellowish.

Dimensions (*in millimeters*).—Tip of snout to anus, 120; tip of snout to second gular fold, 35; tip of snout to anterior border of tympanum, 28; tip of snout to center of eye, 17; tip of snout to posterior border of occipital plate, 24; width of head, 23; length of front leg, 53; length of hind leg, 75; length from base of fifth hind toe to tip of fourth toe, 27.

Remarks.—This species is easily distinguished from *umbra* and *tuberculatum* by the characters used in the synopsis of the species presented above. Its closest relative is *plica* with which it may be best compared as follows:

Character	*P. stejnegeri*	*P. plica*
Supraoculars	Smaller, not band-like	Larger, bandlike.
Dorsal crest	Moderate	Low.
Serrations of dorsal crest	Thin	Usually much thicker.
Size of dorsal scales	Moderate	Small.
Posterior tibials	Strongly spinose	Not spinose.
Legs	Short and heavy	Longer and more slender.

The tail of the type specimen is broken.

This species is named for Dr. Leonhard Stejneger.

Genus POLYCHRUS Cuvier

POLYCHRUS ACUTIROSTRIS Spix

1825. *Polychrus acutirostris* SPIX, Spec. Nov. Lacert. Brasil., p. 15 (type locality, Bahia, Brazil).

Paraguay.—Three specimens, No. 58619 from the Hurter collection, and Nos. 4937 and 12182, collected by Captain Page.

POLYCHRUS FEMORALIS Werner

1910. *Polychrus femoralis* WERNER, Mitt. Naturhist. Mus. Hamburg, Jahrb. Hamburg, Wiss. Anst., vol. 27, beiheft 2, p. 21 (type locality, Guayaquil, Ecuador).

Ecuador.—One specimen, No. 12271, a *topotype* from Guayaquil, which agrees well with the characters set forth in the original description. The ventral scales are unicarinate as in *marmoratus*.

POLYCHRUS MARMORATUS (Linnaeus)

1758. *Lacerta marmorata* LINNAEUS, Syst. Nat., ed. 10, vol. 1, p. 208 (type locality, America).

1820. *Polychrus marmoratus* MERREM, Syst. Amphib., p. 48.

Brazil.—Two specimens, No. 6011 from the Amazon Basin collected by Lieutenant Herndon, and No. 58430 from S. Leopoldina, the latter from the Hurter collection.

Surinam.—One specimen, No. 11044, collected by C. J. Hering in May, 1881.

Trinidad.—Three specimens, No. 5791, collected by T. Gill, and Nos. 17725–26, taken at Port of Spain, by Mr. Roger Welles on August 25, 1891.

Venezuela.—Five specimens, No. 27783 from Macuto collected by M. W. Lyon, jr., Nos. 22520–21, secured on Margarita Island on July 14, 1895, by W. Robinson, and Nos. 27784–85 from Cururuti at 3,000 feet elevation on July 7, 1900, by M. W. Lyon, jr.

Genus PROCTOTRETUS Duméril and Bibron

1837. *Proctotretus* DUMÉRIL and BIBRON, Erp. Gén., vol. 4, p. 266 (type species, *P. pectinatus* Duméril et Bibron).

1857. *Saccodeira* GIRARD, Proc. Acad. Nat. Sci. Philadelphia, p. 197 (type species, *S. ornatissima* Girard).

PROCTOTRETUS AZUREUS (Müller)

1882. *Tropidocephalus azureus* MÜLLER, Verh. Nat. Ges. Basel, vol. 7, pp. 160–161 (type locality, Uruguay).

1885. *Saccodeira azurea* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 160.

Uruguay.—One *topotype*, No. 65535, from Cerro Largo, collected by F. Felippone.

PROCTOTRETUS ORNATISSIMUS (Girard)

1857. *Saccodeira ornatissima* GIRARD, Proc. Acad. Nat. Sci. Philadelphia, p. 198 (type locality, lower cordilleras, just below Obrajillo, and Yanga, Peru).

In the young of this species the black dorsal markings, instead of being more or less irregular and indistinct as in the adult, are regularly arranged, forming paired, light edged triangles on each side of the dorsal crest. Also, the lower surfaces are lighter, with only a few dark markings on the throat, instead of deeply suffused with bluish as in the adult, and apparently the young have smooth head scales or feebly keeled ones.

Peru.—Two specimens, No. 5655, a *co-type* from Yanga, collected by the United States exploring expedition, and No. 75398, taken at Verrugas, Lima, by R. C. Shannon on July 8, 1928.

PROCTOTRETUS PECTINATUS Duméril and Bibron

1837. *Proctotretus pectinatus* DUMÉRIL and BIBRON, Erp. Gén., vol. 4, p. 292 (type locality, Chile).

Argentina.—One specimen, No. 22736 from Bahia-Blanca received from Museo de la Plata.

Genus STENOCERCUS Duméril and Bibron

STENOCERCUS BOETTGERI Boulenger

1911. *Stenocercus boettgeri* BOULENGER, Ann. Mag. Nat. Hist., ser. 8, vol. 7, p. 22 (type locality, Huancabamba, Peru).

Ecuador.—One specimen, No. 61756, collected in 1918 at Loja by J. N. Rose. This example is described as a "green lizard" on the field tag. The preserved specimen is dull, uniform, greenish black, without additional markings. The gular fold is well developed, the throat bluish black, and the other under parts white to grayish.

STENOCERCUS CRASSICAUDATUS (Tschudi)

1845. *Scelotrema crassicaudatum* TSCHUDI, Fauna Peruana, Herpet., p. 28 (type locality, Urubamba, Peru).

1885. *Stenocercus torquatus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 133, pl. 8, fig. 1 (type locality, Peru).

1913. *Stenocercus ervingi* STEJNEGER, Proc. U. S. Nat. Mus., vol. 45, p. 545 (type locality, Huadquinia, Peru).

Peru.—Nine specimens, Nos. 60731–32 taken on September 10, 1915, from the Cosireni River Valley, No. 49550, the type of *Stenocercus ervingi*, from Huadquinia, Nos. 60710–13 and 60736 taken October 15, 1915, at San Fernando on the Rio Cosireni, 4,500 feet elevation, and No. 60725 from Santa Ana at 3,400 feet taken in October, 1915, all collected by members of the Yale-Peruvian Expedition.

Genus TROPIDURUS Wied

The nomenclature of Van Denburgh and Slevin (1913) is followed in dealing with the *Tropiduri* of the Galapagos Islands.

TROPIDURUS ALBEMARLENSIS ALBEMARLENSIS (Baur)

1890. *Tropidurus albemarlensis* Baur, Biol. Centralbl., vol. 10, p. 478 (*nomen nudem*); Festschrift für Leuckart, 1892, pp. 265, 269 (type locality, Tagus Cove, Albemarle Island, Galapagos Archipelago).—Van Denburgh and Slevin, Proc. Calif. Acad. Sci., ser. 4, vol. 2, 1913, p. 172.

1890. *Tropidurus indefatigabilis* Baur, Biol. Centralbl., vol. 10, p. 478 (*nomen nudem*); Festschrift für Leuckart, 1892, pp. 265, 268 (type locality, Indefatigable Island, Galapagos Archipelago).

1892. *Tropidurus jacobii* Baur, Festschrift für Leuckart, p. 269 (type locality, James Island, Galapagos Archipelago).

This form occurs on a number of the Galapagos Islands. The United States National Museum has specimens from four of these:

Albemarle.—Twelve specimens Nos. 15003–11 and 15013, *cotypes*, secured on April 10, 1886, by the United States Fish Commission steamer *Albatross*, and Nos. 58616–7, from the Hurter collection.

Daphne.—Six specimens, Nos. 78395–400, collected by G. Pinchot on June 23, 1929.

Indefatigable.—Sixteen specimens, Nos. 14931–7 and 14939–40, *cotypes* of *T. indefatigabilis* Baur, secured on April 12, 1888, by the United States Fish Commission steamer *Albatross*, Nos. 78388–92 collected on June 23, 1929, by G. Pinchot, and Nos. 58310–1 secured August 8, 1906, from the Hurter Collection.

James.—Twenty-seven specimens, Nos. 14897–14915, and 14917–24, *cotypes* of *T. jacobii* Baur, secured on April 12, 1888, by the United States Fish Commission steamer *Albatross*.

TROPIDURUS ALBEMARLENSIS BARRINGTONENSIS (Baur)

1892. *Tropidurus barringtonensis* Baur, Festschrift für Leuckart, p. 268 (type locality, Barrington Island, Galapagos Archipelago).

1913. *Tropidurus albemarlensis barringtonensis* Van Denburgh and Slevin, Proc. Calif. Acad. Sci., ser. 4, vol. 2, p. 168.

Barrington Island, Galapagos Archipelago.—Two *topotypes*, Nos. 58686–87, from the Hurter collection, collected July 10, 1906.

TROPIDURUS BIVITTATUS (Peters)

1871. *Craniopeltis bivittata* Peters, Monatsber. Berlin Akad. Wiss., p. 645 (type locality, Chatham Island, Galapagos Archipelago).

1889. *Tropidurus lemniscatus* Cope, Proc. U. S. Nat. Mus., vol. 12, p. 145 (type locality, Chatham Island, Galapagos Archipelago).

1913. *Tropidurus bivittatus* Van Denburgh and Slevin, Proc. Calif. Acad. Sci., ser. 4, vol. 2, p. 155.

Chatham Island, Galapagos Archipelago.—Nineteen specimens, Nos. 22125, taken March 29, 1891; 14946–55 and 14959–64, taken

April 4, 1888, from the United States Fish Commission steamer *Albatross;* and Nos. 58308–309, collected on January 25, 1906, from the Hurter collection; Nos. 14946–55 and 19459–64 are *cotypes* of *Tropidurus lemniscatus* Cope. All these are *topotypes* of *bivittatus*.

TROPIDURUS DELANONIS Baur

1890. *Tropidurus delanonis* BAUR, Biol. Centralbl., vol. 10, p. 478 (type locality, Hood Island, Galapagos Archipelago).—VAN DENBURGH and SLEVIN, Proc. Calif. Acad. Sci., ser. 4, vol. 2, 1913, p. 159.

1890. *Tropidurus hoodensis* BAUR, Biol. Centralbl., vol. 10, p. 478 (type locality, Hood Island, Galapagos Archipelago).

Gardners Island, Galapagos Archipelago.—Five specimens, Nos. 14926–30.

Hood Island, Galapagos Archipelago.—Twenty-one specimens, Nos. 15014–18 and 15020–25, taken on April 7, 1888, *cotypes* of *Tropidurus delanonis* and *T. hoodensis* Baur, secured from the United States Fish Commission steamer *Albatross*, Nos. 78401–408, collected in July, 1929, by G. Pinchot, and Nos. 58614–15 taken June 25, 1906, from the Hurter collection.

As noted by Van Denburgh and Slevin (1913) *Tropidurus hoodensis* is a substitute name for *T. delanonis*, having appeared as such in the reprint of the issue of the Biologische Centralblatt cited above. Since there was no preoccupation, the oldest name, *delanonis*, has been applied to the species. From the nature of the case, it is evident that the *cotypes* are the same for both "species."

TROPIDURUS DUNCANENSIS Baur

1890. *Tropidurus duncanensis* BAUR, Biol. Centralbl., vol. 10, p. 479 (type locality, Duncan Island, Galapagos Archipelago).—VAN DENBURGH and SLEVIN, Proc. Calif. Acad. Sci., ser. 4, vol. 2, 1913, p. 147.

Duncan Island, Galapagos Archipelago.—Twenty-two specimens, Nos. 14941–44, taken April 13, 1888, *cotypes*, and 22109–24, *topotypes*, both sets secured on April 2, 1891, by the United States Fish Commission steamer *Albatross*, and Nos. 56890–91, from the Hurter collection, taken in December, 1905.

TROPIDURUS HABELII (Steindachner)

1876. *Tropidurus pacificus habelii* STEINDACHNER, Festschrift Zool.-Bot. Ges. Wien, p. 314, pl. 2, fig. 2 (type locality, Indefatigable [?], and Bindloe Islands, Galapagos Archipelago).

Bindloe Island, Galapagos Archipelago.—Two specimens, Nos. 58484–85, from the Hurter collection, taken on September 17, 1906.

TROPIDURUS OCCIPITALIS BOCOURTII (Boulenger)

1874. *Ancuporus occipitalis* BOCOURT, Miss. Sci. Mexique Amer. Centr., p. 215, pl. 18, fig. 1 (type locality, Peru).

1885. *Tropidurus bocourtii* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 173, [new name for *Tropidurus occipitalis* (Bocourt, 1874), preoccupied by *Tropidurus occipitalis* (Peters, 1871)].

Peru.—Three specimens, Nos. 75962–64, collected at Bellavista by G. K. Noble.

TROPIDURUS OCCIPITALIS OCCIPITALIS (Peters)

1872. *Tropidurus (Laemopristus) occipitalis* PETERS, Monatsber. Berlin Akad. Wiss. (1871), p. 645 (type locality, Peru).

Ecuador.—One specimen, No. 75965, Posorja, Gulf of Guayaquil, collected by G. Baur.

TROPIDURUS PACIFICUS Steindachner

1876. *Tropidurus (Craniopeltis) pacificus* STEINDACHNER, Festschrift Zool.-Bot. Ges. Wien, p. 313, pl. 2, fig. 3 (type locality, Indefatigable ? and Blindloe Islands, Galapagos Archipelago).

1890. *Tropidurus abingdonii* BAUR, Biol. Centralbl., vol. 10, p. 479 (type locality, Abingdon Island, Galapagos).

Abingdon Island, Galapagos Archipelago.—Thirty-seven specimens, Nos. 14966–98 and 15001, *co-types* of *T. abingdonii* Baur, and the *type* No. 14965, both lots secured on April 16, 1888, by the United States Fish Commission steamer *Albatross*, and Nos. 58387–88 from the Hurter collection, taken September 22, 1906.

TROPIDURUS PERUVIANUS (Lesson)

1826. *Stellio peruvianus* LESSON, in DUPERRY, Voy. "Coquille," Zool. Atlas, Reptiles, pl. 2, fig. 2 (photograph); Voy. "Coquille," Zool. Text, vol. 2, pt. 1, 1831, p. 40 (type locality, "Par la mer au pied de Callao, et sur la côte nue et dessechée de Payta," western coast of Peru).

1885. *Tropidurus peruvianus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 174.

1900. *Tropidurus thomasi* BOULENGER, Ann. Mag. Nat. Hist., ser. 7, vol. 6, p. 184 (type locality, Eten, coast of Peru).

1901. *Tropidurus theresiae* STEINDACHNER, Anz. Akad. Wiss. Wien, vol. 38, p. 195 (type locality, Ancon, near Lima, Peru).

The specimens listed on page 26 have been carefully compared, and, on the basis of their variations, it is impossible to recognize *Tropidurus thomasi* Boulenger (1900) as a distinct taxonomic unit. In addition, a topotype of *T. theresiae* Steindachner (1901, U.S.N.M. No. 13980, shows it to be likewise synonymous with the present species.

The collection of *Tropidurus peruvianus* in the United States National Museum may be listed as follows:

No.	Locality	Date	Collector
58307	Chile		Hurter collection.
14056–57	Ecuador	Dec. 18, 1884	W. H. Jones.
5715, 5672, 5704	Peru		United States Exploration Expedition.
17538–40	Peru, San Lorenzo Id	—— —, 1876	H. E. Ames.
13980	Ancon, Peru (*topotype* of *theresiae*).	Oct. 4, 1884	George Keifer.
68735	Coast near Callao, Peru (*topotype*).	Jan. 14, 1884	W. H. Jones.
75415–24	Chosica, Lima, Peru	June 16, 1928	R. C. Shannon.
51514–16	Chosica Canyon, Lima, Peru.		C. H. T. Townsend.
75391–92	Cruz de Hueso, Lima, Peru.	May 13, 1928	R.C. Shannon.
75400	Lima (city), Peru		Alexander Duncan.
38560	Lobos de Tierra, Peru	Dec. 12, 1907	R. E. Coker.
13825	Mollendo, Peru	Sept. 28, 1883	W. H. Jones.
38561–68	North Chincha Island, Peru.	June 11, 1907	R. E. Coker.
73367–68	Paita, Peru (*topotypes*)	—— —, 1927	W. L. Schmitt.
52210	Posco, Peru	Aug. 5, 1914	J. N. Rose.
51517–18	Rio Rimac Valley, Peru [1]	Apr. 8, 1914	C. H. T. Townsend.
75393	Surco, Lima, Peru	May 20, 1928	R. C. Shannon.
51519–20	Verrugas Canyon, Peru	Apr. 8, 1914	C. H. T. Townsend.
75394–97	Verrugas Canyon, Peru	June 25, 1928	R. C. Shannon.

[1] Half way between Verrugas and San Bartolome, altitude 5,250 feet.

TROPIDURUS SPINULOSUS (Cope)

1862. *Microlophus spinulosus* Cope, Proc. Acad. Nat. Sci. Philadelphia, p. 351 (type locality, Paraguay).

Paraguay.—Three specimens, No. 5956, the *holotype*, and No. 4904, both collected by Lieutenant Page, and No. 58848, from the Hurter collection.

TROPIDURUS TORQUATUS HISPIDUS (Spix)

1825. *Agama hispida* Spix, Spec. Nov. Lacert. Brasil, p. 12, pl. 15, fig. 2 (type locality, Bahia, Brazil).

South America.—One specimen, No. 36368.

Brazil.—Three specimens, No. 9324 (*a topotype*), collected at Bahia on July 12, 1874, by J. Russell, No. 52611, collected at Toca de Onça, Bahia by J. N. Rose on June 27, 1915, and No. 58386, taken at Pernambuco in December, 1895, from the Hurter collection.

TROPIDURUS TORQUATUS TORQUATUS (Wied)

1820. *Stellio torquatus* WIED, Reise nach Brasilien (1815–1817), vol. 1, p. 106 (type locality, Brazil).

Argentina.—Two specimens, No. 73503; No. 52962 from Missiones.

Brazil.—Sixteen specimens, Nos. 5668 and 5877 from Rio de Janeiro collected by the United States exploring expedition, and Nos. 15107–19, secured on Abrolhos Island on December 27, 1887 by the United States Fish Commission steamer *Albatross.*

Paraguay.—Two specimens, No. 5857, collected by Captain Page.

South America.—One specimen, No. 5669, received from S. F. Baird.

Family ANGUIDAE

Genus DIPLOGLOSSUS Wiegmann

DIPLOGLOSSUS MONOTROPIS (Kuhl)

1820. *Scincus monotropis* KUHL, Beitr. Zool. Vergl. Anat., p. 128 (type locality, unknown).

1834. *Diploglossus monotropis* WIEGMANN, Herpetologia Mexicana, p. 36.

Colombia.—One specimen, No. 73302, collected in the Choco near the San Juan River by E. J. Paripana.

Ecuador.—One specimen, No. 20609, collected by M. B. Kerr at Plaza de Oro on the Santiago River on February 14, 1893, at 200 feet elevation.

South America.—One specimen, No. 22451, also from M. B. Kerr.

Genus OPHIODES Wagler

OPHIODES STRIATUS (Spix)

1825. *Pygopus striatus* SPIX, Spec. Nov. Lacert. Brasil, p. 25 (type locality, Rio de Janeiro, Brazil).

1885. *Ophiodes striatus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 296.

A careful comparison of specimens from both north and south of the type locality of *grilli*, described by Boulenger (1913) from Parana, Brazil, indicates that it is probably merely a variation of the present species. The most remarkable character attributed to *grilli*, the contact of the azygous prefrontal with the second supraocular, is shown by none of the specimens listed below, although the approach of these two plates is more pronounced in some examples than in others.

The specimens of *striatus* in the collection of the United States National Museum may be listed as follows:

No.	Locality	Collector
9820	South America	United States Navy.
73515–21	Argentina	Breyer Brothers.
5710	Rio de Janeiro, Brazil (*topotype*)	United States Exploration Expedition.
56998	Santa Catharina, Brazil, 1896	Hurter collection.
76366–7	São Paulo, Brazil	Instituto Butantan.
5849	Paraguay	Captain Page.
69873	Chaco, Paraguay	F. Felippone.
75340	Sierra de los Aios, Uruguay	Do.

OPHIODES VERTEBRALIS Bocourt

1881. *Ophiodes vertebralis* Bocourt, Miss. Sci. Mexique Amer. Cent., p. 459 (type locality, southern Brazil and Uruguay).

Eastern South America.—Three specimens, Nos. 17534–36, with doubtful locality data, collected by H. E. Ames.

Family TEIIDAE

Genus AMEIVA Meyer

The writers are now engaged in the preparation of a complete taxonomic revision of the genus *Ameiva*, but are unable to present the final results pertaining to the South American forms at this time.

AMEIVA AMEIVA AMEIVA (Linnaeus)

1758. *Lacerta ameiva* Linnaeus, Syst. Nat., ed. 10, vol. 1, p. 202 (type locality, Brazil).

1915. *Ameiva ameiva ameiva* Barbour and Noble, Bull. Mus. Comp. Zoöl., vol. 59, p. 462.

Among the specimens in the collection of the United States National Museum listed below, Nos. 22526 and 60685 may be regarded as intergrades between *ameiva* and *praesignis*. The white spotting in these rises higher on the back than in typical *ameiva*, but less than in typical *praesignis*.

No.	Locality	Date	Collector
66664	Bolivia		Smithson.
4929	Trinidad, Bolivia		Lieutenant Gibbons.
28960–63	Hyutaihan, Brazil		J. B. Steere.
75966	Minas Geraes, Brazil		Hart and Copeland.
58675	Pernambuco, Brazil	Dec. —, 1895	Hurter collection.
9679	Paramaribo, Dutch Guiana	1858	C. J. Hering.
60685	Santa Ana, Peru, 3,400 feet		Edmund Heller.
60691	do	Dec. —, 1915	Do.
4903	Paraguay		Captain Page.
22526	La Guaira, Venezuela	June 25, 1895	W. Robinson.
27787–8	do	July —, 1900	M. W. Lyon, jr., and W. Robinson.
72752–54	San Juan de los Morros, Aragua, Venezuela.		H. Pittier.

AMEIVA AMEIVA PRAESIGNIS (Baird and Girard)

1852. *Cnemidophorus praesignis* Baird and Girard, Proc. Acad. Nat. Sci. Philadelphia, p. 129 (type locality, Panama).

1915. *Ameiva ameiva praesignis* Barbour and Noble, Bull. Mus. Comp. Zoöl., vol. 59, p. 468.

In the specimens listed below the white spots are continued dorsally to the vertebral line, so the lizards are classified as *praesignis*.

Peru.—Five specimens, Nos. 60686–90, collected at Santa Ana by E. C. Erdis in December, 1915.

AMEIVA ATRIGULARIS (Garman)

1887. *Ameiva surinamensis atrigularis* Garman, Bull. Essex Inst., vol. 19, pp. 2–3 (type locality, Trinidad).

1915. *Ameiva atrigularis* Barbour and Noble, Bull. Mus. Comp. Zoöl., vol. 59, p. 460.

Trinidad.—Four specimens, Nos. 17721–24, collected by G. T. Wayman in 1891.

AMEIVA BIFRONTATA BIFRONTATA (Cope)

1862. *Ameiva bifrontata* Cope, Proc. Acad. Nat. Sci. Philadelphia, p. 67 (type locality, St. Thomas, W. I., probably incorrect, and New Grenada, probably correct).

Margarita Island, Venezuela.—One specimen, No. 22530, collected by W. Robinson on June 30, 1895.

AMEIVA FESTIVA (Lichtenstein)

1856. *Cnemidophorus festivus* Lichtenstein, Nomencl. Mus. Zoöl. Berol., p. 13 (type locality, Veragoa).

1862. *Ameiva eutropia* Cope, Proc. Acad. Nat. Sci. Philadelphia, p. 62 (type locality, Truando River, Colombia).

Colombia.—Two specimens, No. 4320, *co-types* of *Ameiva eutropia* Cope, from the Truando River Valley, northwestern part, collected by A. Schott.

AMEIVA SEPTEMLINEATA Duméril

1851. *Ameiva septemlineata* Duméril, Cat. Méth. Coll. Reptiles (Paris), p. 114 (type locality, South America).

1868. *Holcosus bridgesii* Cope, Proc. Acad. Nat. Sci. Philadelphia, p. 306 (type locality, not mentioned in original description).

1915. *Ameiva bridgesii* Barbour and Noble, Bull. Mus. Comp. Zoöl., vol. 59, p. 478.

The *Ameiva septemlineata* of Barbour and Noble (1915) is not this species, but *Ameiva edracantha* Bocourt.

Ecuador.—Two specimens, No. 33860 from the Alausi Valley, collected by S. A. Davis, and No. 60522 from San Rafael, taken by J. B. Rorer.

Genus ANADIA Gray

As indicated by Loveridge (1929), it seems inadvisable to attempt anything like a generic revision of these highly variable and little known lizards at this time. From all appearances, it is very likely that future workers will make great changes in the nomenclature of this genus.

ANADIA BITAENIATA Boulenger

1903. *Anadia bitaeniata* BOULENGER, Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 430 (type locality, Escorial and Culata, Venezuela).

Two Venezuelan specimens, U.S.N.M. Nos. 66842–43, collected under rocks in damp places at 10,300 feet altitude in the valley of the Chama River in December, 1923, by E. P. de Bellard, may as well be referred to this species as to any other, since many of their characters are those described by Boulenger. Their variation may be outlined as follows: Frontonasal of uneven width, somewhat narrower than long; nasal entire; 4 pairs of postmentals, the anterior 2 in contact medially (No. 68843), or 3 postmentals on one side of the median suture and 4 on the other, the anterior (2 on one side and 1 on the other) of these "paired" units in contact, and the 2 posterior pairs separated by the anterior gular granules (No. 68842); 14 to 17 scales between the chin shields and the edge of the collar; 4 anterior preanals, 6 posterior; 7 or 8 femoral pores on each side; 34 scale rows around the middle of the body; 48 to 52 segments from the occiput to the base of the tail; two supraoculars (*sic!*); 8 to 10 large collar scales; blackish brown above, slate below.

Genus BACHIA Gray

BACHIA INTERMEDIA Noble

1921. *Bachia intermedia* NOBLE, Ann. New York Acad. Sci., vol. 29, p. 142 (type locality, Perico, Department of Cajamarca, Peru).

Peru.—One *paratype*, No. 59927, collected at Perico, the type locality, by the Harvard-Peruvian expedition in 1916.

BACHIA PARKERI Ruthven

1925. *Bachia parkeri* RUTHVEN, Proc. Boston Soc. Nat. Hist., vol. 38, p. 103 (type locality Chenapowu River, "on the upper Potaro River", British Guiana).

This name was primarily based on five specimens from the type locality. With these was associated a sixth specimen in the United States National Museum, No. 65437, collected at Rio Tiquiè, southeastern Colombia, by Mr. G. McCreagh. Its chief characteristics may be summarized as follows: Supraocular 1; superciliaries 2; interparietal absent; upper labials separated from parietals; one pair of

postmentals in contact medially; longitudinal body scale rows in 26 series; transverse body segments 48 to 50; fore limb with 3 unclawed digits, hind limb undivided.

Genus CALLOPISTES Gravenhorst

CALLOJISTES FLAVIPUNCTATUS (Dumeril and Bibron)

1839. *Aporomera flavipunctata* DUMÉRIL and BIBRON, Erp. Gén., vol. 5, p. 72 (type locality, the "Nouveau-Monde").
1845. *Callopistes flavipunctatus* GRAY, Cat. Liz. Brit. Mus., p. 17.

Peru.—One specimen, No. 38559, received from R. E. Coker.

CALLOPISTES MACULATUS Gravenhorst

1838. *Callopistes maculatus* GRAVENHORST, Nova Acta Acad. Caes. Leop.-Carol., vol. 18, pt. 2, p. 744 (type locality, Chile).

Chile.—Three specimens, No. 5844, taken at Atacama by C. H. Reynolds, No. 17537, secured on San Lorenzo Island (?) by H. E. Ames, and No. 5517, found at Santiago by Lieut. J. M. Gilliss.

Genus CNEMIDOPHORUS Wagler

CNEMIDOPHORUS LEMNISCATUS LEMNISCATUS (Linnaeus)

1758. *Lacerta lemniscata* LINNAEUS, Syst. Nat., ed. 10, vol. 1, p. 209 (type locality, "Guinea," *lapsus calami* for Guiana).
1839. *Cnemidophorus lemniscatus* DUMÉRIL and BIBRON, Erp. Gén., vol. 5, p. 128.

Brazil.—One specimen No. 6008, from the Amazon Valley, collected by Lieutenant Herndon.

Colombia.—Two specimens, No. 4352, secured at Cartagena, New Grenada, by A. Schott, and No. 12240, taken at Truando by the same collector.

Venezuela.—Fifteen specimens, No. 58452, from the Hurter collection, Nos. 22528–29, taken at La Guaira on June 21, 1895, by W. Robinson, No. 27786 taken on July 2, 1900, and 27809–16 taken on July 25, 1900, at La Guaira by M. W. Lyon, jr. and W. Robinson, Nos. 27829–30, found near the Rio Chico 100 miles east of La Guaira by L. Goldschmidt, and No. 72751, from San Juan de los Morros, Aragua, secured by H. Pittier.

CNEMIDOPHORUS MURINUS MURINUS (Laurenti)

1768. *Seps murinus* LAURENTI, Synops. Reptil., p. 63 (type locality, "Guiana," probably incorrect).
1834. *Cnemidophorus murinus* WIEGMANN, Herpetologia Mexicana, p. 27.

Curaçao, Dutch Leeward Islands.—Three specimens, No. 13680, secured February 10–18, 1884, United States Fish Commission steamer *Albatross*, No. 27789, taken June 30, 1900, by M. W. Lyon, jr. and W. Robinson, and No. 22527, collected by W. Robinson on July 30, 1895.

Genus DRACAENA Daudin

DRACAENA GUIANENSIS Daudin

1803. *Dracaena guianensis* DAUDIN, Hist. Nat. Reptiles, vol. 2, p. 423 (type locality, Saint-François River, Brazil).

South America.—One specimen, No. 71729, received from A. Foehl, jr.

Genus EUSPONDYLUS Tschudi

1845. *Euspondylus* TSCHUDI, Fauna Peruana, Herpet., p. 41 (type species, *E. maculatus* Tschudi).

1881. *Prionodactylus* O'SHAUGHNESSY, Proc. Zool. Soc. London, p. 231 [type species, *Cercosaura* (*Prionodactylus*) *manicata* O'Shaughnessy].

Since the keeling of the dorsal scales is highly variable in specimens belonging to this section, it has been necessary to unite *Euspondylus* and *Prionodactylus*.

EUSPONDYLUS OCKENDENI HOLMGRENI (Andersson)

1914. *Prionodactylus holmgreni* ANDERSSON, Arkiv. Zool., vol. 9, no. 3, p. 9 (type locality, San Fermin, northwest Bolivia).

This lizard is very closely allied to *E. ockendeni ockendeni* of adjacent areas in Peru.

A single specimen of *holmgreni*, U.S.N.M. No. 59013, which has no definite locality data, shows the characters of the subspecies, as follows: 3 supraoculars; nasal plate divided; 1 frontonasal; 27 transverse series of ventral plates; 37 scales from the occiput to the base of the tail; 30 scales around the middle of the body.

EUSPONDYLUS OCKENDENI OCKENDENI (Boulenger)

1907. *Prionodactylus ockendeni* BOULENGER, Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 486 (type locality, Carabaya, eastern Peru).

1911. *Prionodactylus spinalis* BOULENGER, Ann. Mag. Nat. Hist., ser. 8, vol. 7, p. 23 (type locality, Huancabamba, eastern Peru).

Euspondyli in southern Peru show a range of variation which includes the diagnoses of both *ockendeni* and *spinalis*. Barbour and Noble (1921) have shown that the type locality of *spinalis* is no doubt in error and that the species may be considered as belonging to the area of southern Peru. Therefore, the previously described *ockendeni* takes precedence over *spinalis*.

The variation exhibited by the specimens listed below may be summarized as follows: Supraoculars 3 or 4; nasal plate divided or entire; 1 frontonasal; 20 transverse series of ventral plates; 40 to 45 scales from the occiput to the base of the tail; 40 to 46 scales around the middle of the body; dorsal scales smooth or keeled, often smooth anteriorly and keeled posteriorly.

The specimens of *ockendeni* in the collection of the United States National Museum may be listed as follows:

No.	Locality	State	Collector
60663–72	Occobamba River Valley, at Tocopoqueyu, southern Peru.	July 25, 1915	Edmund Heller.
60729	Ollantaytambo, Peru, 9,400 feet.	July 14, 1915	Do.
60745	Cosireni River, southern Peru	Aug. —, 1915	Do.

EUSPONDYLUS VERTEBRALIS (O'Shaughnessy)

1879. *Cercosaura (Pantodactylus) vertebralis* O'Shaughnessy, Ann. Mag. Nat. Hist., ser. 5, vol. 4, p. 298 (type locality, Intac, Ecuador).

1885. *Prionodactylus vertebralis* Boulenger, Cat. Liz. Brit. Mus., vol. 2, p. 394, pl. 21, fig. 2.

The specimens listed below show the following variation: 2 or 3 supraoculars; nasal plate divided or entire; 1 frontonasal; 20 transverse series of ventral plates; 32 to 34 scales from the occiput to the base of the tail; 33 to 38 scales around the middle of the body.

Colombia.—Two specimens, No. 75968, collected at the Quindio Mountains, Department of Tolima, and No. 75967, collected at San Pedro, near Medellin, both secured by Nicéforo Maria.

Genus GYMNOPHTHALMUS Merrem

GYMNOPHTHALMUS LAEVICAUDUS (Cope)

1870. *Tretioscinus laevicaudus* Cope, Proc. Amer. Philos. Soc., vol. 11, p. 557 (type locality, Occidental Department, Nicaragua).

1876. *Epaphelus sumichrastii* Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 115 (type locality, Costa Rica).

1885. *Gymnophthalmus sumichrasti* Bocourt, Miss. Sci. Mexique et Amer. Cent., Rept., p. 471, pl. 20 H, fig. 2.—Boulenger, Cat. Liz. Brit. Mus., vol. 2, p. 428.—Ruthven, Misc. Publ. Mus. Zool. Univ. Michigan, no. 8, 1922, p. 64.

1885. *Tretioscincus laevicauda* Boulenger, Cat. Liz. Brit. Mus., vol. 2, p. 426.

1887. *Gymnophthalmus laevicaudus* Cope, Bull. U. S. Nat. Mus., no. 32, p. 46.

As shown by Cope (1887), his *Gymnophthalmus sumichrastii* and his *Tretioscincus laevicauda*, which were recognized as distinct from each other by Boulenger, 1885, and certain later writers, are one and the same species. Cope's error in making the original generic diagnosis of *laevicaudus* and his subsequent failure to describe its true generic characters no doubt led Boulenger (1885) to retain *laevicaudus* as a form of *Tretioscincus* instead of referring it to the genus *Gymnophthalmus*.

A specimen of *laevicaudus*, U.S.N.M. No. 72755, collected at San Juan de los Morros, Aragua, Venezuela, by H. Pittier may be de-

scribed as follows: Nasal entire; prefrontals in moderate contact; supraoculars 2, the posterior section extremely small; dorsal scales smooth; longitudinal scale rows, 12; segments from the occipital region to the base of the tail, 32 or 33; femoral pores four on each thigh; back and sides without trace of lines; under surfaces light; tail light brownish.

GYMNOPHTHALMUS LINEATUS (Linnaeus)

1758. *Lacerta lineata* LINNAEUS, Syst. Nat., ed. 10, vol. 1, p. 209 (type locality, Zeilona).—ANDERSSON, Bihang Svenska Vet.-Akad. Handl., vol. 26, sect. 4, No. 1, 1900, p. 16 (systematic consideration of the type specimens).

1766. *Lacerta quadrilineata* LINNAEUS, Syst. Nat., ed. 12, vol. 1, p. 371 (type locality, North America?).

1768. *Seps lineatus* LAURENTI, Synops. Reptil., p. 60 (type locality, Zeilona).

1820. *Gymnophthalmus quadrilineatus* MERREM, Syst. Amph., p. 74, (South America).—DUMÉRIL and BIBRON, Erp. Gén., vol. 5, 1839, p. 820.—BOULENGER, Cat. Liz. Brit. Mus., vol. 2, 1885, p. 427.—RUTHVEN, Misc. Publ. Mus. Zool. Univ. Michigan, No. 8, 1922, p. 64; Occas. Pap. Mus. Zool. Univ. Michigan, No. 143, 1923, p. 9.—MERTENS, Senckenbergiana, vol. 6, 1924, p. 181.—WERNER, Zeitschr. Wiss. Zool., vol. 125, 1925, p. 538.

1900. *Gymnophthalmus lineatus* ANDERSSON, Bihang Svenska Vet.-Akad. Handl., vol. 26, sect. 4, No. 1, p. 16.

This species was originally described as *Lacerta lineatus* by Linnaeus in the tenth edition of the Systema Naturae, but its name was changed to *L. quadrilineata* in the twelfth edition of that work. Therefore, as maintained by Andersson (1900), who has examined the type specimens in addition to the available literature, the form should be known by the earlier name, or, in modern nomenclature, as *Gymnophthalmus lineatus* (Linnaeus).

Two specimens, U.S.N.M. Nos. 64170–71, collected on the island of Curaçao by T. Gaerste, show the following variations: Nasals entire, or with a faint indication of a lower suture; prefrontals in contact; supraoculars 2, the posterior 1 very small; dorsal scales smooth; 15 scale rows around the middle of the body; about 35 segments from the occiput to the base of the tail; back with four faint lines; light below; tail salmon.

Genus KENTROPYX Spix

KENTROPYX CALCARATUS Spix

1825. *Kentropyx calcaratus* SPIX, Spec. Nov Lacert. Brasil., p. 21 (type locality, "Itapicurú, in provincia Maranhao", Brazil).

1868. *Centropyx pelviceps* COPE, Proc. Acad. Nat. Sci. Philadelphia p. 98 (type locality, "Itapicurú, in provincia Maranhão," Brazil).

The two specimens listed below apparently show no specific differences. The small specimen from Peru has keeled dorsal scales,

so it can not be referred to *K. altamazonicus* Cope, which, after all, may prove to be nothing but a synonym of *calcaratus*.

Brazil.—One specimen, No. 28952, collected at Hyutaihan, Lower Amazonia, by J. B. Steere.

Peru.—One specimen, No. 60744, taken at an elevation of 1800 feet, in the valley of the Rio Comberciato, near the great bend of the Rio Urubamba by Edmund Heller in September, 1915.

KENTROPYX INTERMEDIUS (Gray)

1831. *Teius* (*Centropyx*) *intermedius* GRAY, Synops. Rept., in Griffith's "Cuvier's Animal Kingdom," p. 31 (type locality, Surinam).

Although the dorsal scales in the specimen listed below are strongly imbricate, those in specimens in the collection of the American Museum show not only transition stages, but juxtaposition as well.

British Guiana.—One specimen, No. 58462, from the Hurter collection, taken in 1902.

Genus PANTODACTYLUS Duméril and Bibron

PANTODACTYLUS BUCKLEYI BUCKLEYI (O'Shaughnessy)

1881. *Leposoma buckleyi* O'SHAUGHNESSY, Proc. Zool. Soc. London, p. 233 (type locality, Canelos, Ecuador).

1885. *Alopoglossus buckleyi* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 385.

This form is very closely allied to *P. buckleyi festae* Peracca (1904) from which it differs in having the posterior pair of chin shields entirely separated by granules instead of being in contact with each other, at least anteriorly.

A specimen, No. 20613, collected at Plaza de Oro, 200 feet above sea level in the Santiago River Valley, Ecuador, by M. B. Kerr, is apparently referable to this form. It shows the following characters: 28 rows of scales around the middle of the body; 30 scales from the occiput to the base of the tail; 8 rows of transverse gulars, 20 rows of transverse ventrals, and therefore 28 transverse series of plates from the chin shields to the preanal region; femoral pores 7 on each side; ventral plates nearly square, wider in front than behind; chin shields in 3 pairs, the posterior pair nearly separated by granules; temporal scales more or less distinctly keeled, the keeling more pronounced posteriorly.

PANTODACTYLUS SCHREIBERSII (Wiegmann)

1834. *Cercosaura schreibersii* WIEGMANN, Herpetologia Mexicana, p. 10 (type locality, Brazil).

1863. *Pantodactylus bivittatus* COPE, Proc. Acad. Nat. Sci. Philadelphia, p. 103 (type locality, Paysandú, Uruguay).

1885. *Pantodactylus schreibersii* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 388.

There may be either three or four pairs of chin shields in this species.

The specimens of *schreibersii* in the collection of the United States National Museum may be listed as follows:

No.	Locality	Date	Collector
52599	Cordoba, Argentina		Mr. Reed.
70486	Uruguay		F. Felippone.
73915, 68034	Montevideo, Uruguay		Do.
38112–13	Punta Carretas, Montevideo Uruguay.	Nov. 17, 1907	J. Tremoleras.
31279–80	Paysandú, Paraguay (*cotypes of P. bivittatus* Cope)		Dr. H. W. Kennedy
65528	Rincon del Pino, San José, Uruguay.		F. Felippone.

Genus PHOLIDOBOLUS Peters

PHOLIDOBOLUS MONTIUM (Peters)

1862. *Ecpleopus* (*Pholidobolus*) *montium* PETERS, Abhandl. Akad. Wiss. Berlin, p. 196 (type locality, Quito, Ecuador).

Ecuador.—One specimen, No. 71112, collected at Ibarra.

Genus PROCTOPORUS Tschudi

1845. *Proctoporus* TSCHUDI, Fauna Peruana, Herpet., p. 43 (type species, *P. pachyurus* Tschudi).

1862. *Orcosaurus* PETERS, Abhandl. Akad. Wiss. Berlin, p. 201 [type species, *Ecpleopus* (*Oreosaurus*) *luctuosus* Peters].

Andersson (1914) is followed in regarding *Oreosaurus* Peters (1862) as a synonym of *Proctoporus* Tschudi (1845).

PROCTOPORUS ANOMALUS (Barbour and Noble)

1921. *Orcosaurus anomalus* BARBOUR and NOBLE, Proc. U. S. Nat. Mus., vol. 58, p. 614 (type locality, San Fernando, Rio San Miguel, southern Peru).

This lizard appears to differ from *P. ocellifer*, with which it may have to be united, only in the possession of supranasal plates. This unusual feature is unexpected in *Proctoporus* and, as suggested by the specific name, it may be but an abnormality. The *type specimen* of *anomalus* has been added to the collection of the United States National Museum under the number 60704, from San Fernando, 4,500 feet, Edmund Heller, collector.

PROCTOPORUS PETERSI (Boettger)

1878. *Ecpleopus* (*Oreosaurus*) *petersi* BOETTGER, Bericht. Offenbach. Ver. Naturkunde, Nos. 17 and 18, Mittheilungen, p. 9, pl. 1, fig. 2 (type locality, Province of Pará, Brazil, no doubt in error).

1885. *Oreosaurus petersii* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 411.

Specimens of this form from the same locality may show both smooth and keeled dorsal scales on the same or on different individuals (Ñusta Hispaña).

The variation in the specimens of this species in the collection of the United States National Museum has been well discussed by Stejneger (1913) and Barbour and Noble (1921).

No.	Locality	Date	Collector
60726–27	Torenton, Peru, 10,700 feet	May 10, 1915	E. Heller.
60748	Ñusta Hispaña, Peru (*type of Proctoporus obesus*).		E. C. Erdis.
60699–700	Ñusta Hispaña, Peru	June 11, 1915	Do.
60719	Ollantaytambo, Peru, 9,400 feet	May 15, 1915	O. F. Cook.
49549	Ollantaytambo, Peru	July 20, 1911	E. Heller.
60746	Ollantaytambo, Peru, 9,400 feet	July 14, 1915	Do.
49551–52	Tincochchaca, Peru (*Type and paratype of Oreosaurus lacertus*).	Aug. 8, 1911	Yale-Peruvian Expendition.

PROCTOPORUS STRIATUS (Peters)

1862. *Ecpleopus* (*Oreosaurus*) *striatus* PETERS, Abhandl. Akad. Wiss. Berlin, p. 201, pl. 3, fig. 2 (type locality, Santa Fé de Bogotá, Colombia).

1885. *Oreosaurus striatus* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 411.

1885. *Proctoporus striatus* COPE, Proc. Amer. Philos. Soc., vol. 23, p. 98.

1919. *Proctoporus bogotensis* BOULENGER, Proc. Zool. Soc. London, p. 80 (type locality, Bogotá, Colombia).

A single *topotype* of this species, U.S.N.M. No. 76969, collected at Bogotá, Colombia, by Nicéforo Maria, shows the following characters: 35 or 36 scales from the occiput to the base of the tail; 33 scales around the middle of the body; 8 to 10 rows of ventral plates, if 10 are counted, the outer reduced in size; 23 transverse series of ventral plates; a femoral pore on each side; 4 supraoculars; 9 or 10 transverse series of gular plates, including the collar; dorsal scales strongly striated; body brownish above.

Genus TEIUS Merrem

TEIUS TEYOU TEYOU (Daudin)

1803. *Lacerta teyou* DAUDIN, Hist. Nat. Reptiles, vol. 3, p. 195 (type locality, Paraguay).

1885. *Teius teyou* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 379.

South America.—Two specimens, Nos. 11712 and 15333.

Argentina.—Two specimens, Nos. 22754–55, from Corrientes.

Uruguay.—Seven specimens, Nos. 70482–84 and 73533 from Uruguay, No. 73534 from Montevideo, No. 65559 from Carrasco, Montevideo, and No. 70485 from Paysandú, all collected by F. Felippone.

Genus TRETIOSCINCUS Cope

TRETIOSCINCUS BIFASCIATUS (Duméril)

1851. *Heteropus bifasciatus* Duméril, Cat. Méth. Coll. Reptiles, Mus. Paris, p. 182 (type locality, "Vallée de la Madeleine, Nouvelle-Grenade", northeastern Colombia).

1864. *Tretioscincus bifasciatus* Cope, Proc. Acad. Nat. Sci. Philadelphia, p. 229.

Venezuela.—One specimen, No. 61226, collected by Theodore de Boog in Perija, with 16 scale rows around the body and 4 femoral pores on each thigh.

Genus TUPINAMBIS Daudin

TUPINAMBIS NIGROPUNCTATUS Spix

1825. *Tupinambis nigropunctatus* Spix, Spec. Nov. Lacert. Brazil, p. 18 (type locality, Brazil).

Brazil.—Three specimens, No. 38114, supposedly from Para, and Nos. 28953–54, taken at Hyutaihan by J. B. Steere.

British Guiana.—One specimen, No. 12548, brought from Surinam by C. J. Hering.

Peru.—Three specimens, Nos. 60678-80, found in the Valley of the Rio Comberciato, near the great bend of the Rio Urubamba at an altitude of 1,800 feet by Edmund Heller in September, 1915.

Trinidad.—Three specimens, Nos. 17551, 17719, and 32136, collected at Port of Spain by G. T. Wayman.

TUPINAMBIS RUFESCENS (Günther)

1871. *Tejus rufescens* Günther, Proc. Zool. Soc. London, p. 541 (type locality, Mendoza, Argentina).

Argentina—Six specimens, Nos. 73506–508, collected by the Byerer Bros., No. 22735 from the Province of Buenos Aires, No. 12315 from Rio Vermejo, received from the La Plata expedition, and No. 47952 from Santa Fe, Rio Salada, the latter collected by W. Frakes.

TUPINAMBIS TEGUIXIN (Linnaeus)

1758. *Lacerta teguixin* Linnaeus, Syst. Nat., ed. 10, vol. 1, p. 208 (type locality, South America).

Brazil.—Three specimens, No. 12150, collected by Captain Page, No. 59056, taken in 1905 from Bahia, and No. 58618 from Santa Catharina, the last two being part of the Hurter collection.

Family AMPHISBAENIDAE

Genus AMPHISBAENA Linnaeus

AMPHISBAENA ALBA Linnaeus

1758. *Amphisbaena alba* LINNAEUS, Syst. Nat., ed. 10, vol. 1, p. 229 (type locality, America).

Trinidad.—One specimen, No. 5788, collected by Prof. Theodore Gill.

AMPHISBAENA BOHLSII Boulenger

1894. *Amphisbaena bohlsii* BOULENGER, Ann. Mag. Nat. Hist., ser. 6, vol. 13, p. 344 (type locality, Asuncion, Paraguay).

Paraguay.—One specimen, No. 11259, collected by E. Palmer.

AMPHISBAENA CAMURA Cope

1862. *Amphisbaena camura* COPE, Proc. Acad. Nat. Sci. Philadelphia, p. 350 (type locality, Paraguay).—BOULENGER, Ann. Mag. Nat. Hist., ser. 6, vol. 13, 1894, p. 344.

The inadequate original description of this form has been amplified by Boulenger (1894), who incorrectly synonymized it with *Amphisbaena darwinii* in 1885. One type specimen has 76 scales in an annulus at the center of the body.

Paraguay.—Two *co-types*, No. 5860, collected by Capt. Thomas J. Page.

AMPHISBAENA DARWINII Duméril and Bibron

1839. *Amphisbaena darwinii* DUMÉRIL and BIBRON, Erp. Gén., vol. 5, p. 490 (type locality, Montevideo, Uruguay).

The specimens of this lizard in the collection of the United States National Museum may be listed as follows:

No.	Locality	Collector
73513	Argentina	Breyer Brothers.
22763	La Plata, Argentina	Museo de la Plata.
70475–76	Uruguay	F. Felippone.
65612	Cerro Largo, Uruguay	Do.
65539	Durazno, Uruguay	Do.
65529	Maldondo, Uruguay	Do.
68033	Montevideo, Uruguay (*topotypes*)	Do.
73535	Montevideo, Uruguay (*topotypes*)	Do.
65526–27	San José, Uruguay	Do.

AMPHISBAENA FULIGINOSA Linnaeus

1758. *Amphisbaena fuliginosa* LINNAEUS, Syst. Nat., ed. 10, vol. 1, p. 229 (type locality, America).

The specimens of *Amphisbaena fuliginosa* in the collection of the United States National Museum may be listed as follows:

No.	Locality	Date	Collector
12453, 12508	South America		
7364	Pará, Brazil		B. B. Austin.
6118	Surinam		C. J. Hering.
14030	Ecuador	Dec. 18, 1884	W. H. Jones.
58739	Surinam	1899	J. Hurter.
5751	Trinidad		Professor Thomas.
5787	Trinidad		Theodore Gill.

AMPHISBAENA PERICENSIS Noble

1921. *Amphisbaena pericensis* NOBLE, Ann. New York Acad. Sci., vol. 29, p. 141 (type locality, Perico, Peru).

Peru.—Four specimens, Nos. 59926, 60057–58 and 75970, *paratypes*, collected at Perico by G. K. Noble in 1916.

AMPHISBAENA PLUMBEA Gray

1872. *Amphisbaena plumbea* GRAY, Cat. Shield Reptiles Brit. Mus., vol. 2, p. 36 (type locality, Mendoza, Argentina).

Argentina.—Two specimens, No. 52971, a *topotype* from Mendoza, collected by Renato Sanzin in 1915, and No. 22764, received from Museo de la Plata.

AMPHISBAENA TOWNSENDI Stejneger

1911. *Amphisbaena townsendi* STEJNEGER, Proc. U. S. Nat. Mus., vol. 41, p. 283 (type locality, Piura, Peru).

A. pericensis resembles this species in coloration, number of preanal pores, and in other ways, but apparently differs in having less segments in a ring around the middle of the body (34 instead of 44) and in having less rings on the body and tail (232 rings on the body and 20–23 on the tail, instead of 276 rings on the body and 25 on the tail).

Peru.—One specimen, No. 47087, *the type*, taken at Piura by C. H. T. Townsend on March 14, 1911.

AMPHISBAENA VERMICULARIS Spix

1824. *Amphisbaena vermicularis* SPIX, Spec. Nova Serp. Brasil., p. 73 (type locality, Province of Bahia, Brazil).

Brazil.—Two specimens, No. 6035, secured at Para by C. A. Hapler. These examples differ in having a slightly higher scale count than that listed by Boulenger (1885) for the species, namely:

44 segments in an annulus at the middle of the body, 22 above and 22 below; 227 rings on the body and 30 on the tail.

Genus ANOPSIBAENA Stejneger

ANOPSIBAENA KINGII (Bell)

1833. *Anops kingii* BELL, Proc. Zool. Soc. London, p. 99 (type locality, South America).

South America.—One specimen, No. 17550, collected by H. E. Ames.

Argentina.—One specimen, No. 16619, from Cordova, collected by H. Edwards.

Genus LEPOSTERNON Spix

1824. *Leposternon* SPIX, Spec. Nov. Serp. Brasil., p. 70.
1830. *Lepidosternon* WAGLER Syst. Amph., p. 197.

LEPOSTERNON BOULENGERI Boettger

1885. *Lepidosternon boulengeri* BOETTGER, Zeitschr. f. Naturw., vol. 58, p. 220 (type locality, Paraguay).

In his key (1885), Boulenger says that only the anterior point of the frontal of this lizard is in contact with the rostral, but the three specimens listed below show that it may be rather broadly in contact at times.

Argentina.—Three specimens, Nos. 73510–12, collected by the Breyer Brothers.

LEPOSTERNON MICROCEPHALUM Spix

1824. *Leposternon microcephalus* SPIX, Spec. Nov. Serp. Brasil., p. 70 (type locality, Rio de Janerio, Brazil).

Brazil.—Five specimens, No. 58737 from the Hurter collection, and Nos. 40221–24 from (Rio Humboldt, Cerro do Mar), Province of Santa Catherina, collected by W. Erhardt.

LEPOSTERNON POLYSTEGUM Duméril

1851. *Lepidosternon polystegum* DUMÉRIL, Cat. Méth. Coll. Reptiles, Mus. Paris, p. 149 (type locality, Bahia, Brazil).

Brazil.—Two specimens, Nos. 58347–48, from Pernambuco, taken in December, 1895, a part of the Hurter collection.

LEPOSTERNON SCUTIGERUM (Hemprich)

1820. *Amphisbaena scutigera* HEMPRICH, Verhandl. d. Ges. Naturf. Freunde Berlin, vol. 1, p. 129 (type locality, Brazil).
1885. *Lepidosternon scutigerum* BOULENGER, Cat. Liz. Brit. Mus., vol. 2, p. 469.

The head of this form is tinged with dark brown above and the two chief head plates are very well defined and conspicuous.

Brazil.—One specimen, No. 5670 from Rio de Janeiro, taken by the United States Exploring Expedition.

Family SCINCIDAE

Genus MABUYA Fitzinger

MABUYA AGILIS (Raddi)

1823. *Scincus agilis* RADDI, Mem. matem. fisic. Soc. Ital., Modena, vol. 19, No. 18, p. 62 (type locality, Brazil).
1887. *Mabuia agilis* BOULENGER, Cat. Liz. Brit. Mus., vol. 3, p. 190.

Surinam.—Three specimens, Nos. 11042–43 taken in May, 1881, and 11048, collected by C. J. Hering.

Colombia.—One specimen, No. 58160, from Bocas del Toro, from the Hurter collection, taken in September, 1911.

MABUYA DORSOVITTATA (Cope)

1862. *Mabuia dorsovittata* COPE, Proc. Acad. Nat. Sci. Philadelphia, p. 350 (type locality, Paraguay).

Argentina.—One specimen, No. 73514, collected by the Breyer brothers.

Paraguay.—One specimen, No. 5405, the *holotype*, collected by Capt. T. J. Page.

MABUYA FRENATA (Cope)

1862. *Emoea frenata* COPE, Proc. Acad. Nat. Sci. Philadelphia, p. 187 (type locality, Paraguay River Valley, Paraguay).
1887. *Mabuia frenata* BOULENGER, Cat. Liz. Brit. Mus., vol. 3, p. 194.

Brazil.—One specimen, No. 28950, from Hyutaihan, Lower Amazonia, collected by J. B. Steere.

Paraguay.—Three specimens, No. 5855, *cotypes*, collected by Capt. T. J. Page.

MABUYA NIGROPALMATA (Andersson)

1918. *Mabuia nigropalmata* ANDERSSON, Arkiv Zool., vol. 11, no. 16, p. 8 (type locality, "Brazil, Amazonas, Rio Curuca, tributary to R. Javary", and "San Fermin, N. W. Bolivia").

A small skink in the collection of the United States National Museum, No. 13826, secured at Mollendo, Peru, on September 28, 1883, by Dr. W. H. Jones, is apparently referable to this species. It differs from the common skink, *M. agilis*, and from *M. punctata* (of Tschudi) as well, by the possession of a distinct middorsal light stripe. In addition there are a pair of dorso-lateral light stripes. The dorsal ground color is dark brown and the ventral parts are yellowish, with a bluish tinge. The anterior head scutes are injured, but it appears that the frontoparietal plate is entire as in *nigropalmata* and *frenata*. There are 30 scale rows around the middle of the body, a count common to *agilis*, *nigropalmata*, and *frenata*.

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INDEX

	Page
Agama hispida	26
Alopoglossus buckleyi	35
Amblyrhynchus	6
cristatus	6
Ameiva	28
ameiva ameiva	28
praesignis	28, 29
atrigularis	29
bifrontata	29
bifrontata	29
bridgesii	29
edracantha	29
eutropia	29
festiva	29
septemlineata	29
surinamensis atrigularis	29
Amphisbaena	39
alba	39
bohlsii	39
camura	39
darwinii	39
fuliginosa	40
pericensis	40
plumbea	40
scutigera	41
townsendi	40
vermicularis	40
Amphisbaenidae	39
Anadia	30
bitaeniata	30
Aneuporus occipitalis	25
Anguidae	27
Anisolepis	7
argentinus	8, 9
bruchi	7
iheringii	7
undulatus	7, 8
Anolis	7
aeneus	7
agassizi	7
alligator	7
apollinaris	8
auratus	18
chrysolepis	8
fusco-auratus	8
jacare	8
latifrons	8
lineatus	8
trinitatis	7
Anopsibaena	41
kingii	41
Aperopristis	13, 14
catamarcensis	14
paronae	14
Aporomera flavipunctata	31

	Page
Aptycholaemus	7, 8
longicauda	7-9
Argentina	2, 8, 13–17, 22, 27–28, 36–42
Bachia	30
intermedia	30
parkeri	30
Basiliscus	9
americanus	9
basiliscus	9
galeritus	9
Bolivia	28, 32
Brazil	3, 7–8, 10, 21, 26–28, 31–32, 34–36, 38, 40–42
British Guiana	30, 35, 38
Callopistes	31
flavipunctatus	31
maculatus	31
Calotes chiliensis	14
Centropyx pelviceps	34
Cercosaura manicata	32
schreibersii	35
vertebralis	33
Chile	15–18, 31
festivus	29
Cnemidophorus	31
lemniscatus	31
lemniscatus	31
murinus	31
murinus	31
praesignis	29
Colombia	8–10, 12, 16, 27, 29, 31, 33, 37, 42
Craniopeltis bivittata	23
Diplodactylus gerrhopygus	4
Diploglossus	27
monotropis	27
Diplolaemus	13
bibronii	13
darwinii	13, 14
Dracaena	32
guianensis	32
Dutch Guiana	18–19, 28
Dutch Leeward Islands	5, 8, 31
Ecphymotes obtusirostris	7
undulatus	7
Ecpleopus luctuosus	36
montium	36
petersi	36
striatus	37
Ecuador	5, 7, 9–10, 12, 21–22, 25, 27, 29, 36, 40
Emoea frenata	42
Enyalioides	9
heterolepis	9
laticeps	9
laticeps	9
microlepis	10

	Page
Enyalius	10
heterolepis	9
iheringii	10
microlepis	10
undulatus	7
Epaphelus sumichrastii	33
Euspondylus	32
maculatus	32
ockendeni holmgreni	32
ockendeni	32, 33
vertebralis	33
Galapagos Archipelago	6
Abingdon Island	6, 25
Albemarle Island	4, 23
Barrington Island	23
Bindloe Island	24
Charles Island	4
Chatham Island	4–5, 23
Daphne Island	4, 6, 23
Duncan Island	6, 24
Gardiner's Island	24
Hood Island	4, 24
Indefatigable Island	23
James Island	6
Tower Island	6
Gecko mabouia	3
Gekko rapicauda	6
Gekkonidae	2
Gonatodes	2
albogularis	2
atricucullaris	2
vittatus	2
Gorgona Island	9
Gymnodactylus	2
albogularis	2
horridus	2
vittatus	2
Gymnophthalmus	33
laevicaudus	33
lineatus	34
quadrilineatus	34
sumichrasti	33
Hemidactylus	3
mabouia	3
Heteropus bifasciatus	38
Holcosus bridgesii	29
Holotropis trachycephalus	12
Iguana	10
iguana	10
tuberculata	10
Iguanidae	6
Kentropyx	34
calcaratus	34
intermedius	35
Lacerta ameiva	28
igvana	10
lemniscata	31
lineata	34
marmorata	21
plica	19
quadrilineata	34
teguixin	38
teyou	37
Laemanctus obtusirostris	7
undulatus	7
Lepidoblepharis barbouri	5

	Page
Lepidosternon	41
boulengeri	41
polystegum	41
scutigerum	41
Leposternon	41
boulengeri	41
microcephalum	41
polystegum	41
scutigerum	41
Leiocephalus	11, 12
arenarius	11
caducus	12
ervingi	11
erythrogaster	11
iridescens iridescens	12
lineogularis	11, 12
ornatus	12
ornatus	11, 12
trachycephalus	12
psammodromus	11
rhodogaster	11
Leiolaemus bellii	14
bibronii	14
lineatus	14
nigromaculatus	17
Leiosaurus	13
bellii	13, 14
bibronii	13, 14
catamarcensis	13, 14
darwinii	13, 14
fasciatus	13
Leposoma buckleyi	35
Liocephalus arenarius	11
bolivianus	12
caducus	12
iridescens	12
rhodogaster	11
trachycephalus	12
Liolaemus	14
annectens	17
bibronii	14
catamarcensis	14
chilensis	14
chiliensis	14
cyanogaster	15
darwinii	15
elegans	16
elongatus	15
fitzingerii	15
fuscus	16
hatcheri	16
kingii	16
lemniscatus	16
lineomaculatus	16
multiformis	17
multiformis	17
simonsii	15
nigromaculatus	17
nitidus	17
pictus	17
pictus	17
tenuis	18
wiegmannii	18
Liosaurus	13
catamarcensis	14
darwinii	14

	Page
Mabuya	42
agilis	42
dorsovittata	42
frenata	42
nigropalmata	42
Malpelo Island	7
Microlophus spinulosus	26
Nicaragua	33
Norops	18
auratus	18
Ophiodes	27
grilli	27
striatus	27, 28
vertebralis	28
Oreosaurus	36
anomalus	36
lacertus	37
petersii	36
striatus	37
Pantodactylus	35
bivittatus	35
buckleyi buckleyi	35
festae	35
schreibersii	35, 36
Paraguay	18, 21, 26–28, 36, 39, 42
Patagonia	16–17
Peru	4–5, 11, 16–17, 22, 25, 40
Pholidobolus	36
montium	36
Phyllodactylus	3
abrupteseriatus	3
baessleri	3
baruii	4
galapagoensis	4
daphnensis	4
gerrhopygus	4
guayaquilensis	3
inaequalis	4
leei	4
magister	3, 5
martini	5
microphyllus	5
pulcher	5
tuberculosus	3, 5
Plica	18
plica	19
stejnegeri	1, 18–20
tuberculatum	19
umbra	19
Polychrus	21
acutirostris	21
femoralis	21
marmoratus	21
Prionodactylus	32
ockendeni	32
spinalis	32
vertebralis	33
Pristidactylus	13
Proctoporus	36
anomalus	36
bogotensis	37
obesus	37
ocellifer	36
pachyurus	36
petersi	36
striatus	37
Proctotretus	21
azureus	21
cyanogaster	15
darwinii	15
fitzingerii	15
kingii	16
multiformis	17
ornatissimus	22
pectinatus	22
pictus	17
tenuis	18
wiegmannii	18
Pseudogonatodes	5
barbouri	5
Ptenodactylus	13
Pygopus striatus	27
Saccodeira	21
azurea	21
ornatissima	22
Scartiscus	12
caducus	12
Scelotrema crassicaudatum	22
Scincidae	42
Scincus agilis	42
monotropis	27
Seps lineatus	34
murinus	31
South America	6, 9–10, 26–28, 32, 37, 40–41
Stellio torquatus	27
Stenocercus	22
boettgeri	22
crassucaudatus	22
ervingi	11, 22
torquatus	22
Surinam	10, 21, 35, 40
Teiidae	28
Teius	37
intermedius	35
teyou	37
teyou	37
Tejus rufescens	38
Thecadactylus	6
rapicaudus	6
Tobago	7
Tretioscincus	33, 38
bifasciatus	38
laevicaudus	33
Trinidad	6–8, 10, 19, 20, 29, 38–40
Tropidocephalus azureus	21
Tropidurus	23
abingdonii	25
albemarlensis	23
albemarlensis	23
barringtonensis	23
barringtonensis	23
bivittatus	23
bocourtii	25
delanonis	24
duncanensis	24
habelii	24
hoodensis	24
indefatigabilis	23
jacobii	23
lemniscatus	23–24
nigromaculatus	17

Tropidurus—Continued. Page
occipitalis bocourtii 25
occipitalis 25
pacificus 25
habelii 24
peruvianus 25–26
spinulosus 26
theresiae 25
thomasi 25
Tropidurus—Continued. Page
torquatus hispidus 26
torquatus 24
Tupinambis 38
nigropunctatus 38
rufescens 38
teguixin 38
Uraniscodon plica 19
Uruguay 18, 21, 28, 36–37, 39
Venezuela 2, 6, 8, 10, 20–21, 28–31, 38

A REVISION OF THE SPECIES OF COCCOPHAGUS, A GENUS OF HYMENOPTEROUS, COCCID-INHABITING PARASITES

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INTRODUCTION

The beneficial insect investigations of the citrus experiment station are conducted primarily for the purpose of introducing and establishing in California parasitic and predacious insects that may be of aid in combating our insect pests. A certain amount of taxonomic work is necessary to acquaint us with the parasites with which we are dealing. Probably no genus of coccid-inhabiting parasites is of more economic value than is *Coccophagus*, for the species of this genus appear to be the most numerous and widely distributed. So far as known, the species of *Coccophagus* are essentially primary parasites mostly inhabiting lecaniine scales. Accidental secondary parasitism is frequently encountered when species of *Coccophagus* compete with other parasites for the possession of a host. One species, *C. leptospermi* Girault, is recorded as having been reared from a gall on *Leptospermum*, but it is suspected that this parasite issued from a gall-like coccid. *C. javensis* Girault is recorded from a *Pseudococcus* species collected on Mango. *C. gurneyi* Compere is a parasite of *Pseudococcus gahani* Green, a serious pest of fruit trees and ornamental trees and shrubs. The introduction of *C. gurneyi* Compere from New South Wales into California gives promise, at this writing, of being one of the most valuable importations of recent years. The extensive collecting of Mr. E. W. Rust, formerly parasite collector for the citrus experiment station, has revealed a number of different *Coccophagus* inhabiting certain species of *Ceroplastes* which occur in South Africa. The parasites of *Ceroplastes* that occur in Africa may prove of value if established in certain parts of the Orient and Australia where several species of *Ceroplastes* are serious pests of cultivated plants.

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The host records of *Coccophagus* are meager and many of them are incorrect, due to unsatisfactory determinations. Practically all of the Australian species obtained by Girault were described from one or several poorly preserved specimens captured by sweeping; consequently their hosts are unknown. The life histories of only a few species have been studied and, so far, they have proven to be essentially primary in habit. It is not safe to conclude that all the species will prove to be primaries, since they are adaptable when competing for the possession of a host and under certain conditions develop as secondary parasites. It is but a short step from accidental secondary parasitism to obligatory secondary parasitism. A species of *Euxanthellus*, a genus very closely related to *Coccophagus*, is known to be an obligatory hyperparasite.

This paper is No. 172, of the studies made at the University of California, Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside, California. It is based largely on a study of specimens in the United States National Museum, the Brisbane Museum, the E. W. Rust collection, the Silvestri collection, and the British Imperial Bureau of Entomology collection. The types of all species described as new in this paper are to be deposited in the United States National Museum. For the privilege of studying this material the author expresses his appreciation to Dr. L. O. Howard, Dr. H. A. Longman, Dr. F. Silvestri, Dr. Guy Marshall, Mr. A. B. Gahan, and Mr. E. W. Rust. To Dr. F. Silvestri I am indebted for his kindness in loaning me the cotypes of the species which he described and for the privilege of describing several new species which he collected. To Mr. Gahan and Mr. Timberlake I am especially indebted for much assistance freely given. Mr. Timberlake loaned his unpublished notes, Mr. Gahan critically read the first draft of the manuscript and suggested changes which have been made. The help which Mr. Gahan and Mr. Timberlake have given is more fully acknowledged in the text.

GEOGRAPHICAL DISTRIBUTION

The distribution of *Coccophagus* has been greatly influenced by commerce, for like the coccids which they inhabit, species of *Coccophagus* are particularly liable to accidental transportation through the interchange of nursery stock. They pass the greater part of their life cycle within their hosts, and when inhabiting coccids they are easily transported from one locality to a new one. Many of the coccids that serve as hosts of *Coccophagus*, infest plants of economic importance and are transported with nursery stock from one country to another. For this reason it is not always possible to determine the native habitat of a cosmopolitan species nor is it safe to assume that a species is an indigene of the particular country

where it was first discovered. The following cases are cited as examples: *C. ochraceous* Howard was first reared in 1887 from *Lecanium* species infesting a native Californian plant at Alameda. In recent years the same species was discovered to be a common parasite of *Saissetia olea* (Bernard) at Cape Town, South Africa, but its true identity was not known at the time and it was purposely introduced into Southern California from Africa. *Coccophagus scutellaris* (Dalman), first described from Europe in 1825, is of world-wide distribution. It was again described as a new species from Europe in 1852, from California in 1894, and from Australia in 1917.

PRESERVATION OF SPECIMENS

If specimens of *Coccophagus* are not immediately mounted, they are preserved best if the specimens are placed in small vials and packed or held firm by loose absorbent cotton so as to prevent movement and avoid breakage. Some workers prefer the specimens preserved in alcohol but this causes the colors to fade. If only one specimen is obtained, it is of most value if mounted on a tag. The antennae and wings of tag-mounted specimens can be removed from the body at any time and mounted in balsam, or the entire insect can be removed from the tag, treated and mounted on a slide if desired. It is unsatisfactory to make a tag mount of a specimen that has been once preserved in balsam. Certain characters, especially coloration, are studied to best advantage in tag mounted specimens and other characters are seen to best advantage in slide mounts, so if sufficient material is obtained, a few of the specimens can be advantageously mounted in balsam on slides. Unfortunately, most, if not all, the species of *Coccophagus* shrink soon after death. This shrinkage, which causes the head and abdomen to partially collapse or fold, prevents the use of certain characters that would prove of good taxonomic value if it were not for this distortion. Dry and shriveled specimens can be distended by several methods before mounting them in balsam. If, before mounting in balsam, specimens are boiled in an 8 per cent solution of caustic potash, then passed through a bath of acetic acid and afterwards soaked in oil of cloves, they are distended, and the soft internal parts destroyed. Specimens treated in this manner, and then mounted in balsam, clearly show details of structure not readily seen in untreated specimens. The coloration of boiled specimens is partly destroyed and they are distorted by distention of the intersegmental tissue, but the chitinous parts are not affected. Shriveled antennae can be removed from tag mounted specimens and made suitable for study by treating them as described before, mounting them in balsam. Wings are best preserved by mounting them in balsam without any preliminary treatment other than cleaning them if necessary. Because

of their shape, mandibles assume different positions when mounted in balsam and it is extremely difficult to orient all of them in the same position after the cover glass is in place. For this reason mandibles are best studied in oil of cloves or soft balsam so they can be manipulated with dissecting needles before a permanent mount is made.

Unfortunately, a great many species of *Coccophagus* are known only from single poorly preserved specimens. A scientific classification of the group based on fundamental characters can not be made until additional properly preserved specimens are obtained. In this paper, especially in the key, superficial, unstable characters have of necessity been used. Coloration is the most conspicuous and easily seen character but unfortunately it is the most unreliable.

SYSTEMATIC POSITION

The genus *Coccophagus* is imperfectly defined, as it is a heterogeneous assemblage containing species that partially intergrade with other genera. The characters that separate *Coccophagus* from *Prospaltella*, *Encarsia*, *Aneristus*, *Prococcophagus*, *Aspidiotiphagus*, and *Coccophagoides* are relative and cannot be sharply defined. As a matter of convenience, the original generic grouping is adhered to in this paper, thus excluding the *Prospaltella*-like species described as *Coccophagus* by Girault. Girault recognized that *Prospaltella* and *Coccophagus* intergrade in the case of certain species and synonymized *Prospaltella*. In doing so, he wrote: "For extreme *Prospaltella* forms compare *abnormicornis* and allies. These form a distinct genus but there may be intervariations." In the same article Girault removes the so-called extreme *Prospaltella* forms, namely *abnormicornis*, *singularis*, and *regulus* from *Coccophagus* to the genus *Coccophagoides* which he established for their reception.[1] It seems inconsistent to synonymize one genus while erecting a new genus for the reception of the annectant species. Regardless of this inconsistency, *abnormis*, *singularis*, and *regulus* seem to represent a group more unlike typical *Coccophagus* than is *Prospaltella* and as such are probably entitled to generic rank. In the assemblage of species included under *Coccophagus* in this paper are some specimens that differ from the type species more than do certain other species for which separate genera have been erected. Until these parasites are better understood it is thought best to maintain the present generic concepts.

[1] Girault, A. A., Memoirs Queensland Museum, vol. 4, pp. 47, 53–55, 58, 1915.

The following key may aid in defining the position of *Coccophagus* in its relation to allied genera.[2]

1. Antennae eight-jointed 2
   Antennae nine-jointed, funicle four-jointed ..... **Euxanthellus** Silvestri.
2. Scape usually fusiformly subcylindrical, not strongly expanded nor strongly compressed 3
   Scape strongly compressed and expanded ..... **Prococcophagus** Silvestri.
3. Flagellum not compressed, funicle joints usually plainly longer than wide 4
   Flagellum compressed, funicle joints about as wide as long or wider than long ..... **Aneristus** Howard
4. Mesoscutum with a reduced number of small setae, less than 18, arranged in bilateral symmetry 6
   Mesoscutum usually plainly densely setose, in a few species with a reduced number of setae or microscopic pale setae; *Coccophagoides* with about 24 setae in bilateral symmetry 5
5. Flagellum of antenna plainly differentiated into club and funicle. Marginal vein plainly more than one-half as long as the submarginal vein ..... **Coccophagus** Westwood
   Flagellum not differentiated into club and funicle, flagellum tapering toward the apex. Marginal vein unusually short, about one-half as long as the submarginal vein. Stigmal vein intermediate between *Coccophagus* and *Prospaltella* ..... **Coccophagoides** Girault.
6. Antennal club composed of three joints differentiated from the funicle 7
   Antennal club composed of two joints, or the club and funicle not differentiated ..... **Encarsia** Forster
7. Fore wings very slender with the marginal fringe usually longer than the greatest width of the wing ..... **Aspidiotiphagus** Howard
   Fore wings not so narrow as in the foregoing and the marginal fringe usually plainly less than the width of the wing ..... **Prospaltella** Howard

MORPHOLOGICAL CHARACTERS

Head.—Due to shrinkage if the specimens are preserved dry, and because of distortion or concealment if mounted in balsam, such characters as the proportions and shape of the head are not easily utilized. In fresh material, these characters can be noted but the taxonomist rarely obtains specimens that have not partly shriveled.

Mandibles.—These are extremely variable, ranging from sharply tridentate in some species to edentate in others, with the greater number having a more or less typical mandible characterized by a well-developed apical tooth and a broad dorsal truncation that may be more or less incised so as to form a median and inner tooth. The mandibles usually possess two stout peg-shaped ventral spines and a similar but weaker dorsal spine in addition to the setae. Unfor-

[2] I am unable to detect good generic characters to distinguish these genera, but believe that since the genus is an arbitrary category established to aid in the recognition of species, better results are obtained if group distinctions are perpetuated where hundreds of species are involved even though certain species intergrade and exact generic concepts can not be established. With a little practice it is not difficult to assign most species to one genus or another and confusion results only when the intergrading species are encountered.

tunately, the mandibles can not be seen in many species known only from a single poorly preserved type specimen so the value of this character can not be fully utilized.

Antennae.—These have been used to a great extent in this paper, for with few exceptions the antennae of all the type specimens can be more or less clearly seen. However, in the use of the illustrations and of the table of measurements, some allowance should be made, since many of the drawings were made from poorly mounted specimens. Even when actually viewing the specimens, it is not always possible to perceive the true proportions since there may be a foreshortening due to an oblique position, or the lateral aspect showing the greatest width may be seen in one specimen and not in another. In a few cases some of the antennal joints were obscured by the head or other parts, and such obscured parts are indicated in the drawings by broken lines; such reconstruction is more or less hypothetical and can not always be interpreted as being accurate. Also, some of the antennae had shriveled before being mounted in balsam and in such cases the outlines were drawn with the idea of depicting the parts as they appeared before shrinkage. In preparing the descriptions of the antennae, a camera lucida drawing was first made, then the individual joints were measured; the descriptions were based on the drawings and measurements thus obtained. As a result, differences were noted that were not appreciable to the unaided eye. The detailed measurements were obtained for the purpose of making the descriptions more accurate and not with the intention of including them in the paper for publication. It has been found that these measurements are of some aid in separating certain closely allied species and that the descriptions can be better understood if the actual dimensions are given, since very slight differences, not always apparent to the unaided eye, have been described. The species of *Coccophagus* may be divided into two groups on the basis of antennal characters. Many of the small yellow species have the pedicel longer than the first funicle joint, the first funicle joint the shortest, the second and third funicle joints successively longer. The great majority of species have the pedicel distinctly shorter than the first funicle joint, the first funicle joint the longest, the second and third funicle joints successively shorter and wider. A few species are intermediate and not easily assigned to one group or the other. With few exceptions, the funicle joints are plainly longer than wide. The number and arrangement of the sensoria is of taxonomic value and this detail is shown in the drawings.

Palpi.—Maxillary palpi two-jointed, labial palpi one-jointed. The relative lengths of the palpal joints differ among certain species but this character has not been used as the differences are not especially marked and frequently none of the specimens are mounted in a way that reveals the mouth parts.

Thorax.—The notal sclerites of the thorax offer characters of good taxonomic value. The scutellum may be strongly transverse and much shorter than the mesoscutum or it may be almost as long as wide and longer than the mesoscutum. Many species appear to have the scutellum longer than wide but this is an optical illusion for measurements always showed the scutellum to be actually a trifle wider than long. The so-called "post-scutellum" or median part of the metanotum, which is usually differentiated by sculpture and coloration, may be small and inconspicuous or large and prominent. A large prominent median piece is usually correlated with a transverse scutellum. The shape of the propodeum is variable but this character has been generally disregarded because of the difficulty of obtaining specimens in which this sclerite is mounted in a uniform position.

Abdomen.—The shape and size of the abdomen offers an excellent character, easily seen, but it can not be satisfactorily used since it is particularly liable to distortion by shrinkage in dried specimens on tags and by crushing or flattening in slide mounted specimens. Some species have a relatively narrow abdomen and exserted ovipositor, others have a rotund abdomen and concealed ovipositor. The relative lengths of the ovipositor as seen through the body wall of semi-transparent, balsam mounted specimens have proven of value and they have definitely enabled the recognition of certain species previously confused. *C. bivittatus*, new species was confused with *C. longifasciatus* Howard before the marked difference in the relative lengths of the ovipositors was discovered. The outer plates of the ovipositor are extremely variable and would prove of value in a system of classification if properly prepared specimens were available for study. On the sides of the third, fourth, and fifth tergites of many dark colored species are small areas of microscopic markings which have been of aid in the recognition of certain species very closely alike.

Wings.—Many species of *Coccophagus* have a characteristically shaped fore wing, in which the anterior and posterior margins expand evenly without an accentuated, posterior, apical bulge and the apical anterior curvature is evenly rounded. The relative lengths of the submarginal and marginal veins furnish taxonomic characters of considerable value. The postmarginal vein is short and is present in most species, although in a few it is entirely absent. The stigmal vein is short with an apical knob or swelling and is of value in enabling the recognition of species. The greater part of the forewing is usually densely ciliated and the marginal fringe is short. There is no hairless streak obliquely descending from under the stigmal vein but in some species there is a more or less complete hairless streak extending from beneath the apical termination of the sub-

marginal vein towards the basal posterior margin. There are numerous departures from the typical wing and in such cases an effort has been made to figure the wing or describe it in detail. The wings may be hyaline, faintly infuscated or with a well marked infuscated pattern.

Legs.—Aside from noting the length of the basitarsus relative to the length of the tibial spur of the middle legs, and the length of the basitarsus relative to the succeeding joints, no other leg characters have been used except in the case of *C. zebratus* Howard which is anomalous in having the hind coxae and femora greatly swollen. The short tarsal joints of certain species aid in their recognition but the great majority of *Coccophagus* have the basitarsus of the middle legs about as long as its succeeding three or four joints united and the tibial spur slightly shorter than the basitarsus.

Vestiture.—The vestiture furnishes a very convenient character for the separation of the species into two groups. Those having the scutellum about as densely setose as the mesoscutum are placed in one group while those having the scutellum furnished with but three pairs of bristles are placed in the other group. This division is not a fundamental one, since some species of one group are structurally similar to some of those of the other group. *C. trifasciatus* Compere is intermediate between these two groups, for in addition to the three pairs of bristles a varying number of small setae are scattered near the anterior pair of bristles. A few species contain individuals having two or three supernumerary setae in addition to the paired bristles. The great majority of species of *Coccophagus* have the mesoscutum densely setose, only a few of the small yellow species having fewer setae on the mesoscutum. In all the species of *Prospaltella* seen by me, the setae are few and arranged in longitudinal rows, while in *Coccophagus* the setae are more numerous and not arranged in four parallel rows. However, this character seems very superficial and may not apply to all the species. Each axilla is usually furnished with two setae or bristles. *C. redini* Girault has the axillae as densely and conspicuously setose as the mesoscutum, while *C. mariformis*, new species and *C. malthusi* Girault have, in addition to the two large setae, some supernumerary setae that are easily overlooked. An undescribed African species, known only from a single individual in the Rust collection, has the axillae setose. The size, arrangement, and abundance of the setae on the head, body and legs are of taxonomic importance in some cases and can be conveniently used to distinguish certain species.

Sculpture.—The character of the sculpture is best studied in cleared balsam-mounted specimens. The sculpture as seen in a cleared balsam-mounted specimen appears quite different from the same sculpture seen in a tag-mounted specimen. The sculpture of

Coccophagus is composed primarily of reticulated lines and setigerous punctures. The varied punctulate and shagreened effects seen in tag mounts are due to the differences in the fineness of the pattern and size of the raised lines or reticulations and to the size and abundance of the setigerous punctures.

Color.—The varied color patterns furnish the most conspicuous and easily seen taxonomic characters. Unfortunately, coloration is not always reliable, for certain species are extremely variable. Other species have a very uniform color pattern. *C. ishiii*, new species, has been described as new on the basis of the different coloration of the fore coxae. This species is not readily separated from *C. scutellaris* (Dalman) by any structural characters known to me. It differs from *C. scutellaris* (Dalman) principally by having the fore coxae black, in contrast to the remainder of the fore legs, which are yellow, and in contrast to the fore coxae of *C. scutellaris* which are yellow and concolorous with the remainder of the fore legs. In this case, the distinction seems justified, for *C. scutellaris* is represented in our collection by a large series of specimens and the coloration of the legs is constant. On the other hand, a color difference such as this is not of sufficient value to justify separating certain other forms. A series of *C. malthusi* Girault exhibits an amazing range of color variation and if it were not for the intergrading specimens the extreme variants could not be recognized as being specifically alike. On the basis of coloration three species described by Girault, namely, *C. leptospermi*, *C. triguttatus*, and *C. triangulatinotus* seem quite distinct, yet in structure and size they seem suspiciously alike. If they prove to be as variable in coloration as is *C. malthusi* Girault, it is not unlikely that they will prove to be specifically identical; however, this can not be determined from an examination of the badly mounted types. Many of the species are most conveniently separated on the basis of coloration, for this can be seen at a glance. However, coloration can not be used as the basis for an exact and scientific classification.

DESCRIPTIONS OF GENERA AND SPECIES

Genus COCCOPHAGUS Westwood

Coccophagus Westwood, Philosophical Mag., vol. 3, p. 344, No. 32, 1833.
Aphelinus Walker (part), Monographia Chalciditum, p. 11, 1839.
Coccobius Ratzeburg (part), Ichneumonen der Först-Insekten, vol. 3, p. 15, 1852.
Coccophagus Howard, U. S. Dept. Agr. Rept. for 1880, pp. 353–54, 1881; U. S. Dept. Agr. Bur. Ent. Bull. 5, pp. 24–25, 1885; Aphelininae of N. Amer. Div. Ent., U. S. Dept. Agr. Tech. Series No. 1, pp. 10–11, 31–32, 1895.—Ashmead, Mem. Carnegie Mus., vol. 1, pp. 344–46, 1904.—Masi, Boll. Lab. Zool. Gen. Agr., vol. 1, pp. 238–246, 1907.—Schmiedeknecht, Gen. Insect., fasc. 97, 1909.—Mercet, Trab. Mus. Cienc. Nat., No. 10, pp. 219–20, 1912.

The genus *Coccophagus* was erected by Westwood in 1833 to include four species; namely, *Entedon scutellaris* and *Entedon insidiator* of Dalman, described in 1825, and *C. pulchellus* and *C. obscurus* described as new. In 1840, Westwood designated *C. scutellaris* (Dalman) as the type of the genus *Coccophagus*.[3] Since then a total of 130 species has been described under *Coccophagus* or referred to it. In 1834, Nees ab Esenbeck under *Eulophus* described the species *flavovarius* and *impeditus* and in the supplement referred *E. flavovarius* to *C. scutellaris* (Dalman) and *E. impeditus* to *C. obscurus* Westwood.[4] *Eulophus flavovarius* is now recognized as a species of *Tetrastichus*. Walker, 1839, overlooked the genus *Coccophagus* and described five species under *Aphelinus;* namely, *argiope*, *inaron*, *moeris*, *idaeus*, and *lycimnia*.[5] Three species, *argiope*, *inaron*, and *moeris* are accepted as valid by certain European authors and *idaeus* and *lycimnia* placed in synonymy but authorities do not agree regarding the synonymy. Förster, 1841, described the species *semicircularis* under the genus *Myina* Nees.[6] The genus *Myina* is a synonym of *Aphelinus* but the species *semicircularis* is a *Coccophagus* and has been synonymized. A second species was described by Förster as *Myina scutellaris*. Dalla Torre referred the species to *Aphelinus* and proposed the new specific name *försteri*. Silvestri cites this as doubtful synonymy of *Coccophagus howardi* Masi. Ratzeburg, 1852, erected the genus *Coccobius*, and described five species.[7] Of these, *notatus* was transferred to *Coccophagus* by Howard.[8] Howard made *Coccophagus citrinus* Craw the type of his genus *Aspidiotiphagus*.[9] *Coccophagus aurantii* described by Howard, 1894, was transferred by its author to *Prospalta*, 1895.[10] The name *Prospalta* was found to be preoccupied and Ashmead proposed the new name *Prospaltella*, 1904. *Coccophagus varicornis* Howard was made type of Howard's genus *Physcus*.[11] *Coccophagus orientalis* Howard was synonymized with *Aneristus ceroplastae* by Gahan in 1924. According to Howard, *Coccophagus annulipes* Ashmead belongs to *Aphycus*; *C. brunneus* Provancher and *C. compressicornis* Provancher probably belong to the Tetrastichinae; while *C. pallipes* Provancher belongs to *Sympiesis*.[12]

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[3] Westwood, Introduction to the Modern Classification of Insects, vol. 2, 1840, Synopsis of the British Genera of Insects, p. 73.

[4] Nees ab Esenbeck, Hymenopterum Ichneumonibus affinium Monographie, vol. 2, pp. 163–64, 178. Addenda et amendada ab., vol. 2, p. 428, 1834.

[5] Walker, Monographia Chalciditum, pp. 5, 9–12, 1839.

[6] Förster, Beitrage zur Monographie der Pteromalinen, p. 44, 1841.

[7] Ratzeburg, Ich. die Först-Insecten, vol. 3, pp. 188, 196, 1852.

[8] Howard, U. S. Dept. Agr. Div. Ent. Bull. 1, p. 10, 1895.

[9] Howard, Insect Life, vol. 6, p. 231, 1894.

[10] Howard, U. S. Dept. Agr. Div. Ent. Tech. Ser. No. 1, p. 41, 1895.

[11] Idem, pp. 43–44.

[12] Idem, p. 32, 1895.

In this paper the following 22 species described by Girault under *Coccophagus* are referred to *Prospaltella: albiscutellum*, *aleurodici*, *antiopa*, *ashmeadi*, *aureolus*, *boswelli*, *brittanicus*, *clariscutellum*, *filius*, *lautus*, *magniclavis*, *nigriventris*, *perbellus*, *perpulchellus*, *perseus*, *picithorax*, *pulliclavus*, *schilleri*, *seminigriclavus*, *swifti*, *thoreauini*, and *unifasciata*. *Coccophagus lucani* Girault is known to me only by the original description, and from this it is impossible to judge whether the species should be included under *Coccophagus* or referred to *Prospaltella*.[13] In the same article where *C. lucani* is described, Girault refers to *C. tennysoni* as being notably different. I am unable to find any other reference to this species in the literature and suppose it to be *nomen nudum*. In his diagnosis of the Australian species of *Coccophagus*, Girault gives the distinguishing characters of a male specimen, *C. poei*, and says: "See description." In a footnote he writes that the description was lost and that the species *poei* is a *nomen nudum*. However, the diagnostic characters given in the table describe the species more completely than do many of Girault's formal descriptions, so it seems that the name is valid even though it is doubtful if the species can be recognized by the meager description of a male specimen.[14] *Coccophagus sophia* Girault and Dodd [15] and *C. clarus* Dodd are here referred to *Prospaltella*.[16] Brèthes, 1913, erected the genus *Paracharitopus* for the reception of the species *lecanii*. In his unpublished catalogue, Timberlake transferred this species from *Paracharitopus* to *Coccophagus*. If judgment may be based on Brèthes' description, this species is not greatly unlike *C. lecanii* (Fitch). The status of this species can not be determined without making a study of the types. *Coccophagus nubeculus* Brèthes is accepted as a valid species.[17] *Coccophagus subochraceus* Howard is a species of *Euxanthellus*.

KEY TO THE SPECIES OF COCCOPHAGUS, FEMALES [18]

1. Species with the scutellum furnished with only three pairs of bristles, rarely with a few supernumerary setae scattered near the anterior pair of bristles 2

   Species with the scutellum usually about as densely setose as the mesoscutum, in some species setose only on the disk, the sides and apex bare; paired bristles usually present 57

2. Pedicel usually plainly shorter than the first funicle joint. First funicle joint usually the longest, never the shortest, occasionally the funicle joints subequal in length to each other and to the pedicel 3

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[13] Girault, Insecutor Inscitiae Menstruus, vol. 10, Nos. 1–3, p. 108, 1922.

[14] Girault, Memoirs Queensland Mus., vol. 4, p. 55, 1915.

[15] Girault and Dodd, Memoirs Queensland Mus., vol. 4, p. 49, 1915.

[16] Dodd, Trans. Royal Soc. So. Aust., vol. 41, p. 352, 1917.

[17] Brèthes, Anal. Mus. Noc. Bo. As., vol. 24, pp. 97, 105, 1913.

[18] The following species are not included in this key: *C. insidiator* (Dalman), *C. argiope* (Walker), *C. moeris* (Walker), *C. inaron* (Walker), *C. notatus* (Ratzeburg), *C. försteri* (Dalla Torre), *C. obscurus* Westwood, *C. purpureus* Ashmead, *C. nigrifrons* Wollaston, *C. poei* Girault, *C. lucani* Girault, *C. funeralis* Girault, *C. nubeculus* Brèthes. *C. fuscipes* Howard, and *C. eleaphilus* Silvestri run to *C. lecanii* (Fitch).

Pedicel usually plainly longer than the first funicle joint, or if subequal or a trifle shorter than the first funicle joint, the first funicle joint is shorter than the second and third 41

3. Each axilla usually with two setae. In *C. mariformis*, new species and *C. malthusi* Girault there are supernumerary setae, easily overlooked, and in *C. gregarius*, new species three distinct setae 4

Axillae about as densely and conspicuously setose as the mesoscutum. First funicle joint four times as long as wide. Head, legs, and most of thorax yellow. Abdomen blackish. (Australia) ..... 1. **redini** Girault.

4. Coloration of legs normal. Not spotted or banded suggestive of *Marietta* 5

Femora and tibiae pale with brown spots and bands suggestive of *Marietta*. Antennae particolored. An area of transparent cilia on disk of fore wings. (Africa) ..... 2. **lepidus**, new species.

5. Species with the body black, or brownish black, without any yellow markings except the median part of metanotum which may be yellow.[19] 6

Species with the body particolored, or predominately yellow, or purplish 9

6. Legs predominantly black or dark brown, sometimes with the bases or apices yellow. Face and cheeks usually predominantly black or brown 7

Legs predominantly yellow, only the hind tibiae more or less black. Face and cheeks mostly yellow. Tegulae and parapsides suffused with brownish. Scrape concolorous with face, flagellum dark brown. (Florida) ..... 3. **flavifrons** Howard.

7. Face, cheeks and antennae usually completely blackish. Setae on middle knees and dorsal margin of hind tibiae not especially strong, normal 8

Face, cheeks, and antennae usually yellowish or orange, sometimes face and cheeks more or less brown or blackish. Setae on dorsal margin of hind tibiae suberect and slightly stronger than normal. Setae on middle knees rather strong. (Africa) ..... 4. **anthracinus** Compere.

8. Femora and tibiae distinctly tipped with yellow or brownish yellow. Scutellum anteriorly sometimes furnished with two or three supernumerary setae in addition to the three paired bristles. Setae of the knees and fore coxae weak. (Utah) ..... 5. **timberlakei**, new species.

Femora and tibiae not distinctly tipped with yellow but pallid at the ends. The antennae more slender and with fewer sensoria than the foregoing two species. This species can be definitely distinguished from *C. anthracinus* Compere and *C. timberlakei*, new species, by the possession of characteristic markings an the sides of the fifth and sixth tergites as shown in figure 166. (Africa) ..... 6. **atratus** Compere.

9. Fore wings hyaline, or faintly and uniformly tinted, or with a faint cloud beneath the stigmal vein 12

Fore wings distinctly infuscated 10

10. Abdomen pale suffused with brownish. Fore wings generally infuscated. Antennae unusually long 11

Abdomen black. Axillae and scutellum brownish, or ferruginous, sometimes suffused with fuscous. Median part of metanotum and propodeum yellow. Hind coxae, trochanters, and femora yellow. First funicle joint slightly more than twice as long as wide. Third funicle joint only slightly longer than wide. Forewings with a large, distinct, infuscated cloud beneath the marginal vein, more or less interrupted by a diagonal hyaline streak. (Africa) ..... 7. **rusti** Compere.

[19] The word body as used in this paper refers to the thorax and abdomen combined.

11. Only center of pronotum blackish and sides of propodeum dusky. Dorsum of abdomen on apical three-fourths brownish. Wings generally infuscated, the infuscation not especially pronounced. First funicle joint about three times as long as wide. Third funicle joint almost twice as long as wide. (Ceylon)——8. **flavescens** Howard.

12. Scutellum more or less extensively yellow, remainder of thorax and the abdomen predominantly blackish. *C. lecanii* (Fitch) and related forms. Figure 3 illustrates species of this group——30

Otherwise——13

13. Abdomen black or brown, or pale with dark spots or bands, or purplish, or blackish with basal one-third or so yellow——14

Abdomen entirely pale. General color orange with only the meson of pronotum and a spot behind the wing articulations black. (Australia)——9. **perhisidis** Girault.

14. Basal one-third or so of abdomen yellow, remainder black. Thorax black. Habitus of *C. lecanii* (Fitch) and related species. Parasitic on *Pseudococcus* spp. (Australia and California)——10. **gurneyi** Compere.

Otherwise——15

15. Setae on the mesoscutum, axillae and scutellum plainly visible when viewing tag-mounted or uncleared specimens in balsam——16

Setae on mesoscutum, axillae and scutellum delicate, microscopic, hardly visible unless the specimen is cleared and viewed under high magnification. Predominantly yellow. Center of pronotum, anterior part of mesoscutum or meson, a large blotch on each axilla, anterior margin of scutellum, metanotum, propodeum, and dorsum of abdomen brownish or blackish. (Australia)——11. **tarongaensis,** new species.

16. Abdomen pale with darker spots or bands——24

Abdomen completely black, or brown, or purplish. In balsam-mounted specimens if the abdomen is crushed the intersegmental tissue may appear as pale transverse cross stripes——17

17. Abdomen black or brownish——18

Abdomen originally described as purple. Parts described as purple now appear brownish in the balsam-mounted type. Scutellum, median part of metanotum, scape, legs except the fore and middle coxae and base of fore femora, yellow. Abdomen small, shorter than thorax. A robust species with scutellum plainly wider than long. Mesoscutum with rather coarse, sparse setae. (Australia)——12. **signus** Girault.

18. Pedicel almost if not actually wider than long and plainly shorter than the third funicle joint——21

Pedicel plainly longer than wide and subequal in length to the third funicle joint——19

19. Stigmal vein normal. Postmarginal wanting or slightly developed. All club joints wider than long——20

Stigmal vein abnormally swollen. Postmarginal vein well developed. All club joints plainly much longer than wide, subequal; each a trifle longer than any funicle joint. Club not much wider than the funicle. Sensoria and other antennal details as shown in figure 27. Head and thorax mostly orange yellow. Face iridescent pearly white. Middle and hind coxae more or less blackish, remainder of legs yellow. (Africa)——13. **mariformis,** new species.

20. Abdomen not much longer than wide. Hind coxae black in contrast to the remainder of the legs which are yellow. A moderately small species with the following parts blackish: Pronotum, anterior part of mesoscutum, a spot on either parapsis, axillae, metanotum, except median part,

propodeum, abdomen, most of lateral and ventral parts of thorax. Dorsum of head distintly orange with the ocellar area blackish. The following parts yellow: Face, cheeks, mesoscutum except anteriorly, parapsides except the spots, scutellum, median part of metanotum. (Australia)----------14. **emersoni** Girault.

21. Abdomen rounded at apex; ovipositor sheaths not exserted----------22
Abdomen pointed at apex, plainly longer than wide; seventh tergite long, strongly compressed after shrinkage; ovipostor sheaths exserted. Legs mostly lemon yellow, hind coxae and basal half of hind tibiae blackish. Head mostly lemon yellow, occiput mostly black. Mesoscutum black or with a variabe amount of orange on the sides. Scutellum orange, or orange with black anteriorly. Median part of metanotum yellow. Parapsides orange and black. (Africa)----------15. **flaviceps**, new species.

22. Scutellum black with yellow laterally----------23
Head and thorax yellow except for blackish or brownish markings as follows: occiput on either side of foramen, exposed part of pronotum medially, anterior part of mesoscutum in a median -shaped blotch, wedged-shaped bases and a median spot on parapsides, axillae (suffused), sides of metanotum, median part of propodeum between the longitudinal carinae, petiole, tegulae, and dorsal part of mesosternum. Abdomen completely black. Legs completely yellow. Eyes and ocelli reddish. (India)----------16. **tschirchii** Mahdihassan.

23. Head mostly yellow. Mesoscutum black, yellow laterally. Parapsides yellow spotted with black. Scutellum black, yellow laterally. Metanotum, propodeum, and abdomen black. Hind coxae mostly black, remainder of legs yellowish. Each axilla with three setae. (Australia.)
17. **gregarius**, new species.

24. First funicle joint plainly the longest----------25
Funicle joints subequal in length. A small black and yellow species with the habitus of *C. ochraceus* Howard. General color yellow with the following dark brown or blackish markings: upper part of occiput, center of pronotum, anterior margin of mesoscutum, sides of metanotum, center of propodeum, a broad band across middle of abdomen. Antennae and legs yellow. (Java)----------18. **javensis** Girault.

25. Abdomen with rows of spots on either side, or with cross bands, or rows of transverse spots that may coalesce, not with three distinct spots----26
Abdomen yellow with three distinct black spots, one on either side of middle, another at apex. Thorax yellow marked with blackish as follows: center of pronotum, apex of each axilla, anterior margin of scutellum. Legs and antennae yellow. (Australia)----------19. **triguttatus** Girault.

26. First funicle joint plainly much less than three times as long as wide and third funicle joint plainly much less than twice as long as wide. Club joints wider than long. Cilia of forewings normal----------27
First funicle joint almost three times as long as wide, third funicle joint about twice as long as wide. First club joint plainly longer than wide. Cilia of fore wings translucent, abnormally long and dense toward base of wings. Abdomen on either side with two longitudinal rows of dots which on the outer rows are contiguous so as to form more or less continuous lateral bands. Predominantly yellow, face and cheeks white,

frontovertex orange blotched with pearly white. First and second tarsal joints of the middle and hind legs fuscous. An aberrant species with the habitus of *Euxanthellus*. (Africa)_____20. **specialis**, new species.

27. Abdomen with bands or obscure cross stripes_____28

Originally described as having three spots on the abdomen broadly joined together. General color pale yellow marked with blackish as follows: center of pronotum, anterior margin of mesoscutum, axillae, scutellum anteriorly, most of metanotum and propodeum, dorsum of abdomen except approximately first two tergites and sides of fifth and sixth tergites. Head, antennae, and legs yellow. So far as can be determined, structurally similar to *C. triguttatus* Girault and *C. leptospermi* Girault. (Australia)_____21. **triangulatinotus** Girault.

28. Abdomen with a broad band across the middle_____29

Abdomen with a rather obscure cross stripe on the anterior half of each of the first five tergites. Face, cheeks, antennae, legs, sides, and venter of thorax yellow. Thorax yellow marked with blackish as follows: Most of pronotum, anterior margin of mesoscutum on meson, sutures of mesoscutum posteriorly, scutellum anteriorly, axillae anteriorly. (Australia)_____22. **leptospermi** Girault.

29. General color orange. Legs whitish. Abdomen black at apex and with a rather wide black band across the middle. (Australia.)

23. **inkermani** Girault.

30. At least one pair of coxae or one pair of femora entirely pale or yellow__31

All coxae black, or predominantly blackish, or dark brown. All femora usually more or less extensively black or brownish_____37

31. Femora of at least one pair of legs distinctly marked with blackish____35

Femora of all legs pale or yellow_____32

32. Middle and hind coxae partly black_____34

All coxae pale or yellow_____33

33. Face and cheeks pale yellow, frontovertex reddish. Legs pale yellow, only hind femora and tibiae slightly suffused with dusky. Venter and sides of thorax brownish. Fore wings finely and closely ciliated with a small rounded hairless spot near base. Neck of stigmal vein not constricted. Sensoria of antennae more abundant than in the following species. (Java)_____24. **bogoriensis** (Köningsberger).

Face, cheeks, and frontovertex blackish. Legs completely yellow. Venter and sides of thorax yellow. Compared to the foregoing species fore wings rather coarsely and sparsely ciliated. Neck of stigmal vein constricted. Postmarginal vein distinct. (Cuba)__25. **cubaensis**, new species.

34. Fore coxae yellow, middle and hind coxae black. All femora yellow except for a faint brownish suffusion at apex of middle pair. All tibiae and tarsi yellow with a trace of brownish. (Africa.)

26. **pulvinariae**, new species.

35. All femora usually more or less brown or blackish, especially the middle pair_____36

Middle femora yellow; fore femora yellow but often marked with blackish; hind femora blackish. All tibiae usually yellow, fore tibiae occasionally with some fuscous. All coxae more or less blackish. (Japan.)

27. **japonicus** Compere.

36. Hind coxae usually yellow in sharp contrast to the blackish coloration. Middle femora with a distinct pale annulus at base. Tibiae of middle and hind legs either entirely yellow or marked with fuscous. (Hawaii, Japan)----------28. **hawaiiensis** Timberlake.[20]

37. Middle tibiae entirely yellow or more or less uniformly faintly dusky----38
Middle tibiae blackish or dark on the basal two-thirds, yellow or whitish at apex. Coxae, trochanters, and femora of all legs black or dark brown except the femora of the fore and middle legs which are pale at the ends and the latter with a distinct annulus at base. Hind tibiae completely blackish or dark brown. Head and antennae blackish to dark brown. (Philippine Islands)----------29. **tibialis**, new species.

38. Hind tibiae usually distinctly blackish on the basal third or more----------39
Hind tibiae usually entirely yellow, sometimes faintly dusky at the base. Fore wings usually faintly and uniformly smoky, densely and closely ciliated with a small rounded hairless spot near the base. (Africa, Italy.) 30. **cowperi** Girault.[21]

39. Face and cheeks usually blackish or brownish. Femora of fore and middle legs usually definitely and distinctly blackish in part----------40
Face, cheeks, and antennae yellowish; frontovertex orange, occasionally more or less suffused with fuscous. Fore and middle femora rather vaguely and distinctly dusky. (Natal, Africa)-31. **isipingoensis**, new species.

40. Face and cheeks usually blackish or brownish; frontovertex usually brown or fuscous. Scape usually fuscous in contrast to the yellow flagellum. There are exceptions. Femora usually definitely blackish with the ends yellowish. (N. America)----------32. **lecanii** (Fitch). 32*a*. **fuscipes** Howard.
In the female sex hardly separable from the foregoing species. (Consult key to the male forms.) (Eritrea, Africa)------33. **eleaphilus** Silvestri.

41. Ovipositor concealed or shortly exserted----------42
Ovipositor exserted about one-fourth the length of abdomen. General color honey yellow. Axillae and center of pronotum blackish. (Australia.) 34. **biguttatus** Girault.

42. Hind coxae and femora not abnormally swollen----------43
Hind coxae and femora abnormally swollen. Antennae parti-colored. Abdomen whitish with transverse brown bands. (Ceylon)-35. **zebratus** Howard.

43. Scutellum without supernumerary setae scattered near the anterior pair of bristles----------44
Scutellum with a varying number of small setae scattered near the anterior pair of bristles. Funicle joints all about as wide as long or occasionally wider than long. A small species. Face and cheeks yellow: frontovertex orange. Notum of thorax and abdomen black with conspicuous yellow markings roughly defined as three cross bands: first band across the posterior two-thirds of mesoscutum, parapsides, and tegulae; second band across base of abdomen; third band across abdomen near apex. Scutellum mostly black, the sides yellow. (Africa)------36. **trifasciatus** Compere.

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[20] *C. hawaiiensis* Timberlake may be a synonym of *C. japonicus* Compere. Typical specimens are strikingly different in the coloration of the legs but there are intergradations. In the United States National Museum is a series of specimens, all supposedly reared from the same host taken from the same locality, which includes individuals that agree with both the types of *C. japonicus* Compere and *C. hawaiiensis* Timberlake. On the basis of this evidence Gahan concludes that the two forms represent a single species. On the other hand, Timberlake is inclined to the belief that two distinct species are involved. I have spent considerable time comparing the two forms without being able to reach a decision. In the case of *C. pulvinariae*, new species, and *C. isipingoensis*, new species, we are again confronted with two forms that co-exist and have at least one host in common.

[21] Consult key to males on p. 60 for aid in recognition of species in the *C. lecanii* (Fitch) group.

44. Species marked with some black or brownish----47
Species completely pale yellow, without any dark markings. Marginal fringe long ----45
45. Spur of middle tibia subequal in length to the basitarsus. Basitarsus of middle legs as long as the three succeeding joints combined----46
Tibial spur slightly longer than the basitarsus. Basitarsus of middle legs as long as the succeeding two joints combined. Funicle joints plainly much less than twice as long as wide. Face, cheeks, and venter of thorax white. (Africa)----37. **lutescens**, new species.
46. Funicle joints a trifle more than twice as long as wide. (Wisconsin.)
38. **perflavus** Girault.
47. Fore wings hyaline, or with a cloud beneath the stigmal vein, or with normal infuscation. Cilia of fore wings normal----48
Fore wings with a large, elongated, central infuscation with fuscous cilia. On the hyaline area at apex of wing the cilia are transparent in balsam and probably refractive in tag-mounts. Pedicel about as long as the first funicle joint. All funicle joints subequal, each a trifle longer than wide. Club as long as the funicle. A small species, silvery white to yellow with blackish markings. (Australia)----39. **argenteus** Girault.
48. Second funicle joint not the longest, or if the longest, not more than twice as long as wide----49
Second funicle joint slightly longer than the first or third and about two and one-half times as long as wide. First funicle joint a trifle longer than the pedicel. First and third funicle joints subequal and each about two and one-fourth times as long as wide. Fore wings relatively slender and smaller than normal. A small species mostly orange yellow; abdomen black with a broad silvery cross band. (Australia.)
40. **argentifascia** Girault.
49. Body not marked on either side with a longitudinal dark brown stripe---51
Body yellowish, marked on either side with a longitudinal, dark brown stripe continuous from pronotum to apex of abdomen----50
50. Fore wings with a small infuscated cloud beneath the stigmal vein. Ovipositor shorter than in the following species, extending from middle of abdomen to the apex. (Africa)----41. **bivittatus**, new species.
Fore wings without a cloud beneath the stigmal vein. Ovipositor extending almost the entire length of the abdomen. (Ceylon, China.)
42. **longifasciatus** Howard.
51. Stigmal vein normal or if with a long slender neck the postmarginal vein is developed----52
Stigmal vein with an abnormally long slender neck; postmarginal vein absent. Predominantly black with only the basal one-third of the abdomen yellow in striking contrast. (Maryland)--43. **cinguliventris** Girault.
52. Thorax yellow or predominantly yellow with some brownish----53
Thorax predominantly blackish, parapsides and scutellum more or less ferruginous. Head mostly pearly white. Basal one-third or so of the abdomen pale yellow to white, apical one-fourth yellow with dark spots, intermediate part fuscous. Middle and hind coxae black, remainder of legs white to pale yellow. First funicle joint about one-half as long as the second, second and third plainly longer than wide. (Africa.)
44. **margaritatus**, new species.

53. Third funicle joint plainly longer than wide----54
Third funicle joint as wide or wider than long. Thorax light lemon yellow with the concealed part of the pronotum blackish. Abdomen with distinct cross bands. (Australia)----45. **pulcini** Girault.
54. Abdomen yellow, or yellow with black markings----55
Abdomen entirely black; thorax orange yellow. Legs lemon yellow with the hind coxae fuscous. (Australia)----46. **auricaput** Girault.
55. Predominantly yellow without a broad blackish cross band on abdomen---56
Ochraceus to honey yellow marked with blackish to dark brown as follows: collar of pronotum, anterior margin of mesoscutum, occasionally the notal sutures more or less, axillae in some specimens, usually metanotum and propodeum, a broad band across basal half of abdomen, a spot between the cercal plates. First funicle joint about twice as long as wide. (California, Africa)----47. **ochraceus** Howard.
56. Bright yellow, only the tip of scape, flagellum, border of pronotum, tips of tegulae, border of metanotum (propodeum?), and incomplete bands between the abdominal segments fuscous. (Canada)--48. **fletcheri** Howard.[22]
57. Fore wings hyaline or subhyaline, or with a faint small cloud beneath the stigmal vein----65
Fore wings with a large and usually distinct infuscated cloud beneath the apical half of the marginal vein----58
58. Body particolored, at least suffused or spotted with yellowish on the parapsides and tegulae, or basal angles of abdomen with yellow marks----61
Body entirely black----59
59. As seen through the derm walls, the ovipositor extends from the middle of the abdomen to the apex----60
As seen through the derm walls, the ovipositor extends from near the base of the abdomen to the apex. Frontovertex, face, and part of the cheeks ferrugino-testaceous with fuscous suffusions on the latter. Antennae testaceous. (South Africa)----49. **nigritus**, new species.
60. Frontovertex, face, and cheeks brownish or blackish. Antennae fuscous. A robust species of large size with thick legs. Hind tibiae furnished with a row of coarse, suberect black setae on the dorsal margin. (Dahomey, Cotonou)----50. **modestus** Silvestri.
(Union of South Africa)----51. **modestus** var. **capensis**, new variety
61. Thorax entirely black, or predominantly black, at most only touched with yellow in parts----62
Head, dorsum of thorax except metanotum and propodeum, basal abdominal segments ferruginous to yellow. Metanotum and propodeum black. Abdomen mostly black, yellow basally. (Africa)----52. **nubes** Compere.
62. Abdomen black with a conspicuous yellow spot on either side at base----63
Abdomen entirely black. Thorax black except the extreme apex of scutellum and median part of metanotum which are yellow. Hind femora pale yellow in striking contrast. (Africa)----53. **saintebeauvei** Girault.
63. Fore and middle legs entirely pale yellow----64
Fore and middle legs plainly partly blackish. A robust species. Head and antennae mostly, if not entirely, yellow. Thorax mostly black, tegulae, and median part of metanotum yellow. All coxae mostly, if not entirely, black. All trochanters more or less yellow. Fore and middle femora black with yellow ends. Hind femora entirely black. Fore tibiae mostly,

[22] I have not seen this species. It is placed in the key on the basis of the original description.

if not entirely yellow. Middle and hind tibiae black, the latter pale or yellow at ends. All club joints plainly wider than long. (Africa.)

54. **spectabilis**, new species.

64. Differs from the foregoing species principally by the different coloration of the legs. Coxae and trochanters of hind legs yellow in sharp contrast to the blackish coloration of the femora and tibiae. (Africa.)

55. **speciosus**, new species.

65. Abdomen pointed at the apex; seventh tergite long; ovipositor sheaths plainly exserted. Antennal club about as long as the first funicle joint; first two club joints plainly wider than long. First funicle joint about twice as long as wide and provided with three whorls of sensoria. Pedicel slightly longer than wide. Submarginal vein about two-thirds as long the marginal vein. Knees of middle legs with conspicuous, coarse black setae. Dorsal margin of hind tibiae with a row of suberect, strong setae and the paired setae at apex subequal in length 66

Without the above combination of characters 69

66. Hind coxae black 67

Hind coxae and trochanters pale yellow in contrast to the completely black femora and partially black tibiae; tibiae mostly black, pale yellow apically. Fore and middle legs predominantly, if not entirely, pale yellow. Mesoscutum and scutellum mostly yellow or ferrugino-testaceous, the sides of the former blackish. Median part of metanotum pale, the sides blackish. Head yellow except the upper half of the occiput which is blackish. (Africa) ..... 56. **princeps** Silvestri.

67. Fore and middle femora and tibiae entirely lemon yellow 68

Extremely variable in coloration. Hind tibiae black, only the apex yellow. Hind coxae black in contrast to the femora which are predominantly yellow. Femora and tibiae of fore and middle legs usually yellowish with variable fuscous markings. Head and thorax ranging from bright orange yellow to black with innumerable intermediates. In the predominantly black forms usually traces of yellowish can be detected on some of the notal sclerites of the thorax. Intermediates occur having some thoracic sclerites yellow and others black. Abdomen black. (Africa.)

57. **malthusi** Girault.

68. Legs bright yellow except the hind coxae which are blackish and a fuscous suffusion at base of hind tibiae. Head, thorax, and antennae pale orange to yellow, only occasionally slightly marked with blackish. Structurally similar to *C. princeps* Silvestri and *C. malthusi* Girault. (Africa.)

58. **clavellatus**, new species.

69. Species agreeing with the combination of characters given in the first part of couplet 65 except that the first club joint is a trifle longer than wide and the club slightly longer than the first funicle joint. Large species with pale hind coxae in contrast to the blackish coloration 70

Otherwise 72

70. Propodeum entirely black 71

Legs black except the hind coxae and trochanters and all tarsi which are yellow to testaceous. Head and body black except the apex of the scutellum and more or less of the metanotum and propodeum which are orange to yellow. The largest species seen ranging near 2.5 mm. in length. (California) ..... 59. **albicoxa** Howard.

71. According to Gahan extremely like the foregoing species but differs by having the propodeum entirely black, the frons and face brownish

yellow, vertex similarly colored but darker, occiput, temples, and cheeks black, apical one-fourth of scutellum yellow. (Mexico).
60. **mexicanus** Girault.

72. Body entirely black or dark brown 73
Body particolored 79
73. Hind tibiae marked with blackish or entirely black 74
Hind and middle tibiae yellow to whitish. All femora mostly black to dark brown. (Italy) ..... 61. **niger** Masi.
(Mexico) ..... 62. **mexicensis** Girault.[23]
74. Middle tibiae predominantly black or dark brown 76
Middle tibiae entirely pale yellow or whitish 75
75. All femora predominantly black or dark brown, the apices pale. (Japan) ..... 63. **yoshidae** Nakayama.
All femora pale yellow to whitish. (New York) ..... 64. **gossypariae** Gahan.
76. Paired bristles at apex of scutellum plainly less than one and one-half times as long as the scutellum 77
Paired bristles at apex of scutellum one and one-half times as long as the scutellum. Head predominantly dark. Legs entirely blackish brown, only the tarsi obscurely pale. Marginal vein nearly twice as long as the submarginal vein. Scutellum about one and one-half times as wide as long. (India) ..... 65. **acanthosceles** Waterston.
77. Second and third funicle joints plainly longer than wide 78
Second and third funicle joints plainly wider than long. Head and antennae yellow. (Africa) ..... 66. **robustus**, new species.
78. Head and antennae fuscous. Legs mostly blackish brown; fore tibiae pale; middle and hind femora pale at ends. Marginal vein slightly longer than the submarginal vein. (Africa) ..... 67. **quaestor** Girault.
79. Body, exclusive of scutellum, marked with yellow, alutaceous or whitish 83
Body entirely black except for the scutellum which is more or less extensively yellow or orange 80
80. Hind femora mostly, if not entirely, blackish or dark brown. Head blackish or dark brown. Scutellum extensively marked with yellowish 81
Legs mostly whitish, only the hind tibiae blackish, the apex pale. Head mostly lemon yellow; occiput above and ocellar area blackish. Apical curvature of scutellum very narrowly margined with yellow. (Panama) ..... 68. **saissetiae** Gahan.
81. Fore coxae black 82
Fore coxae yellow; middle and hind coxae and hind femora black, remainder of legs yellow. (Europe, Africa, Australia, California).
69. **scutellaris** (Dalman).
82. Similar to the foregoing species except that all the coxae are black. (Japan) ..... 70. **ishiii**, new species.
83. Scutellum particolored, or yellow, or ferruginous, or black with a pale blotch on either side 86
Scutellum entirely black or brownish 84
84. Mesoscutum uniformly black or brownish 85
Mesoscutum particolored, a broad band of yellow or orange extending from tegula to tegula including most of axillae and posterior part of mesoscutum; remainder of thorax and the abdomen black. (California.)
71. **scutatus** Howard.

[23] I have not seen *C. niger* Masi. *C. mexicensis* Girault is in agreement with Masi's description so that it may prove to be a synonym.

85. Propodeum pale or yellow, remainder of thorax and head entirely dark brown or blackish. A moderately small species without any striking characters. (Washington, D. C.)_____72. **immaculatus** Howard.

86. Mesoscutum particolored, or yellow, or alutaceous or ferruginous_____89
Mesoscutum entirely black or brownish_____87

87. Coxae of middle and hind legs black. (Fore legs not seen)_____88
Legs, head, and antennae entirely yellow. Parapsides and axillae mostly yellow. Pronotum, mesoscutum, and abdomen entirely black; median part of propodeum black; remainder of body mostly pale yellow. (France)_____73. **pulchellus** Westwood.

88. Legs yellow except for the middle and hind coxae which are black. (Fore legs missing on specimen studied.) Face and cheeks blackish to dark brown. Pronotum, mesoscutum, axillae, and abdomen black. Parapsides and tegulae suffused with brownish. Scutellum with the anterior part black or entirely orange yellow. Metanotum and propodeum mostly yellow. (Italy)_____74. **howardi** Masi.

89. Apex of scutellum furnished with small setae in addition to a pair of bristles as long as the scutellum_____90
Disk of scutellum about as setose as the mesoscutum, the sides and apex bare except for the paired bristles. Orange yellow with the following parts black: center of occiput, pronotum, anterior margin of mesoscutum, a spot on the expanded part and the wedge-shaped base of each parapsis, metanotum except the median part, abdomen except the basal angles and posterior to the cercal plates. Sternites mostly yellow. According to Girault, antennal scape yellow, remainder black. (Africa.)
75. **nigropleurum** Girault.

90. Lemon yellow marked with dark brown or fuscous as follows: exposed part of pronotum, anterior one-half or so of mesoscutum arcuately, sides of metanotum, center of propodeum between the longitudinal carinae, petiole, and abdomen. Legs entirely pale yellow. (China.)
76. **silvestrii**, new species.

DESCRIPTIONS OF SPECIES

1. COCCOPHAGUS REDINI Girault

Plate 7, Figure 15; Plate 12, Figure 138

Coccophagus redini GIRAULT, Homo Perniciosus and New Hymenoptera. (Chalcidoidea, Braconidae). Brisbane, Australia, April 1924, p. 4. (Author's publication.)

The type female has been crushed beneath the cover glass (fig. 138). Cracks in the cover glass and excess balsam obscure parts to some extent. This species should be recognized without any difficulty by the unusually long first funicle joint and by the axillae which are as densely setose as the mesoscutum.

Female.—Face and cheeks light lemon yellow, dorsum of head more brownish. Thorax yellow except the pronotum, which is entirely black, and the propodeum, which is blackish laterally. Abdomen entirely blackish. Legs pale yellow. Parts of antennae missing in the type; apparently pedicel and first two or three funicle joints fuscous; scape supposedly concolorous with face; club yellowish. The coloration of antennae is difficult to observe.

Scape obscured by cracks and dirt in the balsam; pedicel about one and one-third times as long as wide and very much shorter than the first funicle joint; first funicle joint about four times as long as wide and more than twice as long as the pedicel; second funicle joint twice as long as wide and about two-thirds as long as the first funicle joint; third funicle joint shortest, one and one-half times as long as wide and about three-fourths as long as the second funicle joint. All funicle joints very slightly increase in width distad. Club joints combined not quite as long as the first and second funicle joints combined, and very slightly decreasing in length distad; club slightly wider than the funicle (fig. 15).

Mesoscutum rather densely clothed with short black setae. Each parapsis with about nine setae as strong or slightly stronger than those on the mesocutum. The exact position of the setae as shown in Figure 138 may not be accurate. Axillae with setae like those of the mesoscutum. Scutellum with three pairs of bristles, anterior pair the smallest and not so widely spaced as the center pair; center pair intermediate in size; apical pair on posterior margin and placed slightly further apart than the center pair. (One apical seta is missing and the other broken.) Propodeum with a few small setae in proximity to the spiracles (fig. 138).

Thorax crushed and flattened. Scuto-axillar sutures slightly longer than the scuto-scutellar suture. Possibly as a result of crushing, the scutellum is distinctly wider than long. Metanotum and propodeum without visible sculpture.

Mandibles with a ventral tooth and a broad truncation.

Wings clear hyaline, clothed with rather coarse cilia. Marginal vein almost imperceptibly longer than the submarginal vein. Stigmal vein and postmarginal vein apparently not unlike those of *C. perhispidis* Girault; the outline is two indistinct to be drawn with a camera lucida and the shape can not be accurately determined.

Basitarsus of the middle legs almost as long as the following joints combined; tibial spur as long as the basitarsus.

Ovipositor sheaths shortly exserted but this may be due to distortion.

Measurements in mm.: Thorax 0.6 long. Abdomen 0.54 long. Scutellum 0.18 long by 0.24 wide. Pedicel 0.0560 long by 0.376 wide. First funicle joint 0.1424 long by 0.0360 wide; second 0.0896 long by 0.04 wide; third 0.0712 long by 0.0456 wide. First club joint 0.0680 long by 0.0520 wide; second 0.0672 long by 0.0528 wide; third 0.0640 long by 0.0416 wide. Fore wings 0.98 long. Marginal vein 0.32 long; submarginal 0.30 long. Longest marginal fringe 0.0216.

Redescribed from type female in the Brisbane Museum. No data on slide other than name and designation female type.

2. COCCOPHAGUS LEPIDUS, new species

Plate 7, Figure 16; Plate 14, Figure 186

This species is conspicuously colored, maculated in a way suggestive of *Marietta*. It differs from the type species probably more than any other form included in this revision. The particolored antennae are unusually long. The stigmal vein is abnormally enlarged. Fore wings with a conspicuous large area of hyaline cilia posteriorly, opposite the junction of the marginal and submarginal veins. The ovipositor seems to differ from that of typical *Coccophagus*.

Female.—Frontovertex orange; face and cheeks iridescent, pearly white with a conspicuous black stripe extending from side to side across the clypeus. Coloration of the antennae variable. The majority of specimens have the scape pearly white with a black spot ventrally on the apical third, and a median brownish blotch on the sides and dorsum. Pedicel and first funicle joint brown with testaceous suffusions. Second and third funicle joints testaceous in contrast to the black club. Eyes and ocelli reddish. Exposed sides of pronotum iridescent, pearly white with a black spot on either corner; concealed part blackish. Mesoscutum, parapsides, axillae, scutellum, and sides of metanotum mostly orange yellow; sometimes sides of mesoscutum narrowly edged with iridescent pearly white; parapsides with a small pearly white spot marking the posterior border on the expanded part. Median part of metanotum and sometimes median part of propodeum iridescent pearly white, remainder of propodeum blackish. Abdomen mostly blackish, the dorsum with a broad, conspicuous, white band across the base. The following sternal and pleural parts appear iridescent pearly white: proepisternum, either side of prepectus, and a spot on either end of episternum. Sides of abdomen towards base and extreme apex yellow, when viewed ventrally. Legs iridescent, pearly white to pallid with all joints spotted or banded with fuscous. Apical two tarsal joints of middle and hind legs fuscous. All tarsi of fore legs fuscous.

Pedicel slightly but appreciably shorter than the first funicle joint. Unless actually measured, all funicle joints appear subequal. By actual measurement, the second joint is a trifle longer than the first or third which are of equal length. Each funicle joint about one and three-fourths times as long as wide. Club elongate, as long as the first, second, and one-half of the third funicle joints combined; all joints plainly longer than wide (fig. 16).

Mandibles shown in Figure 186.

Fore wings hyaline except for a small infuscated area beneath the stigma; on the basal third beneath the junction of the submarginal and marginal veins occurs an area of fine, hyaline cilia contrasting with the short coarse dense cilia of the disk. Marginal fringe moderately long, 0.0252 mm. Submarginal a trifle longer than the marginal vein, the difference hardly appreciable. Stigmal vein greatly enlarged at apex.

Scutellum large, slightly wider than long (15:13), about as long as the mesoscutum. Median part of metanotum prominent. Abdomen longer than wide, pointed at apex.

Frontovertex with numerous brown, fine, comparatively long setae. Setae of mesoscutum, except the posterior pair, only slightly stronger than the setae on the frontovertex; the lateral posterior pair much stronger. Each parapsis with three setae, the median one slightly the largest. Each axilla with two strong setae, the posterior one the strongest. Scutellum with three pairs of strong, brownish setae, the apical pair not much stronger than the median pair. Setae of the fourth tergite not forming a row across the dorsum as usual; six setae in transverse alignment across the sixth tergite; scattered setae on the seventh; sides of second, third, and fourth with the lateral setae in irregular transverse alignment.

Measurements in mm.: Head and body 1.20. Scape 0.16 long. Pedicel 0.0520 long by 0.0352 wide. First funicle joint 0.0704 long by 0.0416 wide; second 0.0776 long by 0.0416 wide; third 0.0704 long by 0.0424 wide. First club joint 0.0624 long by 0.0480 wide; second 0.0560 long by 0.0464 wide; third 0.0584 long by 0.0376 wide.

Male.—Coloration of legs and head somewhat like that of female. Antennae ferrugino-testaceous, the scape pale. Mesoscutum with the anterior half occupied by a V-shaped blackish area. Axillae mostly blackish. Disk of scutellum fusco-testaceous, the lateral and apical margins paler. Propodeum and abdomen black. Parapsides orange with a faint central fuscous blotch.

Pedicel small, about two-thirds as wide and less than one-half as long as the first funicle joint. Club not differentiated from the funicle, the joints subequal except the apical one which is obviously smaller; sensoria numerous and extending the entire length of the segments.

Length of head and body 1.20 mm.

Type.—Cat. No. 42089, U.S.N.M.

Described from seven females, six males (holotype, allotype, and paratypes), collected by E. W. Rust at Signal Hill, Cape Town, South Africa, December, 1924, and January, 1925, and bearing. Rust's numbers M–4 and M–5. Questionably parasitic on *Baccacoccus* sp.

3. COCCOPHAGUS FLAVIFRONS Howard

Plate 7, Figure 17; Plate 11, Figure 99

Coccophagus flavifrons Howard, U. S. Dept. Agr. Bur. Ent. Bull. 5, 1885, p. 25.
Coccophagus koebelei Howard, U. S. Dept. Agr. Bur. Ent. Bull. 5, 1885, p. 25.
Coccophagus flavifrons Howard, U. S. Dept. Agr. Div. Ent. Tech. Ser. No. 1, 1895, p. 36.—Mercet, Trab. Mus. Cienc. Nat. No. 10, 1912, p. 228.

A rather distinctive species, predominantly black except for the face and cheeks which are mostly yellow.

Female.—Body black except for the parapsides and tegulae which are suffused with brownish. Frontovertex ferrugino-testaceous and blackish, the latter color predominant; face and cheeks mostly yellow.

Scape yellow, flagellum dark brown. Hind tibiae mostly blackish, paler at the apices, remainder of the legs yellow with faint brownish suffusions.

Pedicel plainly longer than wide and shorter than the first funicle joint. First funicle joint longest, the following successively shorter; all slightly increasing in width distad. First club joint subequal in length to the third funicle joint and a trifle longer than either of the following club joints (fig. 17). The figure of the antenna may not be quite accurate since the funicle and the club of the specimen studied were partly shriveled.

Much of the thorax of the specimen studied is obscured by glue, but apparently the scutellum is slightly wider than long and about as long as the mesoscutum.

Setae of the mesoscutum more or less regularly longitudinally arranged and slightly paler than the integument. Each parapsis with three or four setae. Only a portion of the scutellum visible but presumably provided with three pairs of bristles.

Fore wings hyaline, densely and closely ciliated. Marginal fringe short. Submarginal vein a trifle longer than the marginal; postmarginal shortly produced and shown with stigmal vein in figure 99.

Measurements in mm.: Length of head and body 1.0. Scape 0.1344 long by 0.0344 wide. Pedicel 0.0488 long by 0.0336 wide. First funicle joint 0.0640 long by 0.0384 wide. Beyond the first the funicle joints are shriveled so that the exact widths can not be measured; the lengths of these joints are 0.0536, 0.0496, 0.0496, 0.0448, 0.0456. Fore wings 0.82 long by 0.40 wide. Marginal vein 0.21 long; submarginal 0.24 long. Longest marginal fringe 0.0320.

Male.—Mostly black, tegulae and parapsides slightly brownish. Median part of metanotum yellowish. Mesopleura somewhat brownish. Face and cheeks in proximity to the mouth testaceous. Antennae yellow or testaceous; sensoria fuscous. All femora more or less fuscous, the ends pale. Hind tibia faintly fuscous toward the base.

Redescribed from one female and one male in the United States National Museum determined by Gahan as *C. flavifrons* Howard. Reared from *Toumeyella liriodendri* (Gemelin), Prince Georges County, Md., June 16, 1911, Gahan, Coll.

4. COCCOPHAGUS ANTHRACINUS Compere

Plate 7, Figure 18; Plate 11, Figure 128; Plate 13, Figures 159, 164; Plate 14, Figure 168.

Coccophagus anthracinus COMPERE, Univ. Calif. Publ. Ent., vol. 2, No. 3, 1925, pp. 309–11; Univ. Calif. Publ. Ent. vol. 4, No. 1, 1926, p. 11.

This species can be separated from the majority of *Coccophagus* species by the completely black body, hyaline wings, and three pairs of bristles on the scutellum. It is most likely to be confused with *C. atratus* Compere and *C. timberlakei*, new species. The Rust collection includes a good series of *C. anthracinus* of both sexes. The supposed male of this species was described from two specimens collected in a breeding cage in association with female *C. anthracinus* with which they were attempting to mate. These males are not in agreement with the males associated with *C. anthracinus* in the Rust collection. Since it has been observed that male *Coccophagus* of one species often attempt to mate with females of a different species, it is not safe to conclude that the two sexes are correctly associated just because of their intimate contact. It is more likely that Rust's specimens are correctly associated and that the male previously described as *C. anthracinus* is another species.

Female.—Body usually entirely black to dark brown in parts, in certain lights with metallic reflections. Coloration of the head variable; light colored variants with the face, cheeks, and antennae yellow or orange with occasional traces of fuscous; at the other extreme these parts may be entirely black or dark brown. Frontovertex usually more or less blackish, except the triangular dorso-lateral angles, occipital margin, and ocellar lines which are orange or yellow. Legs predominantly black to brown with pale markings as follows: apices of all femora, the tibiae with variations ranging from pallid with a faint suffusion of brownish to predominantly brown with only the apices rather broadly pallid. Tarsi usually pallid, the apical joints dusky. Generally the hind tibiae are plainly darker than the fore and middle tibiae.

Pedicel not quite one and one-third times as long as wide and plainly shorter than the first funicle joint. First funicle joint longest, not quite one and one-half times so long as wide; second and third subequal in length, each slightly shorter than the first; all almost imperceptibly increase in width distad so that the third is almost as wide as long. First club joint a trifle longer and wider

than the third funicle joint; second and third successively smaller (fig. 18).

Scutellum a trifle wider than long and as long as the mesoscutum. Abdomen, after shrinkage, about as long and as wide as the thorax. Ovipositor concealed.

Fore wings hyaline, densely and finely ciliated with a short fringe; a rounded spot bare of cilia on the posterior basal part. Marginal vein a trifle shorter than the submarginal, the difference only 0.02 mm. and hardly appreciable. In the original description it was said that the marginal vein was longest; this was because of the inclusion of the basal downward bend as a part of the marginal instead of the terminal part of the submarginal vein. Postmarginal vein shortly produced (fig. 128).

Basitarsus of middle legs as long as the succeeding three joints united; tibial spur slightly shorter than the basitarsus.

Antennae clothed with numerous fine, pale setae. Mesoscutum with numerous, short, black setae. Scutellum with the apical bristles longest, the median pair most widely spaced. Each parapsis with four setae. Propodeum with a few, fine setae laterad of the spiracles. Fifth and sixth tergites with a row of setae extending across the dorsum, the rows interrupted on the preceding three tergites and absent on the first; seventh tergite with longer scattered setae.

Mesoscutum rather coarsely reticulated, scutellum not so strongly sculptured. Metanotum with a strong transverse lineolation on either side. Propodeum with two, strong, sublateral carinae. First abdominal tergite and part of the second smooth and shining. Tergites from three to six about as coarsely sculptured as the mesoscutum.

Measurements in mm.: Length of average sized specimen 1.2. Pedicel 0.0536 long by 0.0416 wide. First funicle joint 0.0736 long by 0.0496 wide; second 0.06 long by 0.0552 wide; third 0.06 long by 0.0568 wide. First club joint 0.0624 long by 0.0608 wide; second 0.0480 long by 0.0576 wide; third 0.0416 long by 0.04 wide. Marginal vein 0.26 long; submarginal 0.28 long.

Male.—Except for the usual sexual differences, the males are quite similar to the females. All tibiae predominantly dark brown, the apices pale. Expanded part of parapsides usually faintly suffused with testaceous.

Redescribed from paratypes and many additional specimens in the Rust collection as follows: 15 females and 2 males reared from *Pulvinaria mesembrianthemi* (Vallot), Rosebank, Cape Town, 1923, 1925; 8 females and 4 males reared from *Baccacoccus* species, Signal Hill, Cape Town, 1924; 8 females reared from *Saissetia oleae*

(Bernard), Greenpoint, Rosebank and Mobray, Cape Town, South Africa, 1919, 1924. Rust's numbers M, M–2, and G.

Large colonies of *C. anthracinus* Compere were repeatedly liberated in a number of black scale infested districts of California but so far as we know, the species failed to become established.

5. COCCOPHAGUS TIMBERLAKEI, new species

Plate 7, Figure 19; Plate 11, Figure 124

This species closely resembles *C. anthracinus* Compere and *C. atratus* Compere; in size and coloration it most closely resembles the latter but in antennal and venational characters it is most like *C. anthracinus*. It does not have the distinctive, microscopic markings on the fifth and sixth tergites characteristic of *C. atratus* and the setae of the middle knees are weakly developed unlike those of *C. anthracinus*. In some specimens, this species has a few supernumerary setae on the scutellum in addition to the three pairs of bristles.

Female.—General color black, occasionally with some brownish on the sclerites at the base of fore wings. Antennae brownish black. Coxae of all legs blackish, sometimes with brownish beneath. Trochanters of all legs brownish. Femora of all legs black, distinctly tipped at ends with testaceous or pure yellow, middle pair with an annulus at base. Tibiae of fore legs testaceous suffused with fuscous; those of middle and hind legs black tipped at ends with testaceous. Tarsi of all legs testaceous, more fuscous at apices.

Pedicel somewhat more than one and one-half times as long as wide and slightly shorter than the first funicle joint. First funicle joint slightly the longest, a trifle more than one and one-half times as long as wide; second and third subequal, each a trifle shorter and wider, the difference hardly appreciable with measurements. First club joint slightly wider than long and slightly wider than the third funicle joint; second slightly wider than long and slightly smaller than first club joint; third about as long as the second but much narrower, rounded at apex (fig. 19).

Mandibles with an acute ventral tooth and a broad, slightly concave, dorsal truncation.

Fore wings hyaline. Submarginal vein a trifle longer than the marginal; postmarginal produced as far distad as the stigmal; stigmal as shown in Figure 124. At the base of wing, parallel to the posterior margin, occurs an elongated hairless area which is separated by two rows of cilia from a rounded bare spot. Disk of wing moderately densely ciliated, cilia of moderate size. Marginal fringe short.

Scutellum slightly wider than long (6:5) and about as long as the mesoscutum. Abdomen short, about as wide as long. As seen through the abdominal walls in balsam-mounted specimens, the ovipositor arises near the middle, not exserted.

Basitarsus of middle legs about as long as the four succeeding joints united; tibial spur shorter than the basitarsus. Hind tibial spurs unequal.

Mesoscutum densely setose. Scutellum usually with two or three small setae, similar in size to those of mesoscutum, scattered near the anterior pair of bristles. Each parapsis with four or five setae.

Measurements in mm.: Length of head and body, 1.0. Scape, 0.1488 long by 0.0360 wide. Pedicel, 0.0640 long by 0.0384 wide. First funicle joint, 0.0760 long by 0.0496 wide; second, 0.0656 long by 0.0560 wide; third, 0.0624 long by 0.0640 wide. First club joint, 0.0640 long by 0.0688 wide; second, 0.0576 long by 0.0664 wide; third, 0.0616 long by 0.0432 wide. Marginal vein, 0.25 long; submarginal, 0.31 long.

Type.—Cat No. 42093, U.S.N.M.

Described from 14 females (holotype and paratypes) from collection of P. H. Timberlake with the following data on labels: "Bred from *Pulvinaria bigeloviae* Ckll., collected at Murray Utah, June 7, 1914, by Timberlake; U. S. D. A. No. 14709E."

6. COCCOPHAGUS ATRATUS Compere

Plate 7, Figure 20; Plate 11, Figure 104; Plate 13, Figure 166; Plate 14, Figure 167

Coccophagus atratus COMPERE, Univ. Calif. Publ. Ent., vol. 4, Aug. 18, 1926, pp. 2–4.

A single male designated allotype taken in association with the series of type females, led to the recognition of this form as a species distinct from *C. anthracinus* Compere, for the males associated with the latter were quite different. It is now thought that the males associated with *C. anthracinus* belong to another species although they were paired with females. It is believed, however, that *C. atratus* is a distinct species even though the males of the two forms are not greatly unlike as first supposed.

In addition to the characters given in the original description that supposedly separated the females of *C. atratus* from *C. anthracinus* attention is called to the difference in venation as shown in the figures of the stigmal and postmarginal veins (fig. 104). Also, in this species the sixth tergite in proximity to the abdominal spiracles and a more extensive area on the fifth tergite is marked as shown in Figure 166. In *C. anthracinus* and *C. timberlakei* these peculiar marks are not evident.

7. COCCOPHAGUS RUSTI Compere

Plate 6, Figure 13; Plate 7, Figure 21; Plate 10, Figure 75; Plate 11, Figure 112; Plate 14, Figure 174

Coccophagus rusti COMPERE, Univ. Calif. Publ. Ent., vol. 4, No. 9, 1928, pp. 261–62, fig. 12.

This is a distinctive species, fore wings generally infuscated beneath the marginal vein; in tag-mounted specimens, the abdomen shrinks in a characteristic manner, appearing plainly smaller than the thorax, spatulate in shape; also, in tag mounts the thorax appears wider than usual. The coloration is also distinctive.

Female.—In general, head, mesoscutum, and parapsides ferrugino-testaceous. Axillae and scutellum dark brown or testaceous with some fuscous. Metanotum medially and entire propodeum light yellow; sides of metanotum light yellow. Mesopleura blackish brown. Abdomen entirely blackish. Frontovertex ferrugino-testaceous; face more brownish, deepening to fuscous under the eyes. Scape concolorous with the face, remainder of antennae blackish. Hind coxae, trochanters, and femora light yellow, concolorous with propodeum; tibiae suffused with fuscous basally. Middle coxae mostly blackish; trochanters, femora, and tibiae brownish touched in parts with fuscous. Fore legs similar to the middle legs except that the coxae are not so dark. All tarsi brownish.

Pedicel somewhat more than one-half as long as the first funicle joint, almost one and one-half times as long as wide. First funicle joint plainly the longest, slightly more than twice as long as wide; second and third successively decreasing in length and increasing in width so that the third is only slightly longer than wide. First club joint a trifle shorter and wider than the third funicle joint; succeeding club joints slightly decreasing in size distad; third almost one and one-half times as long as wide (fig. 21).

Mandibles shown in Figure 174.

Fore wings rather extensively infuscated beneath the marginal vein with a diagonal pale streak extending from the base of marginal vein downward and outward to near the posterior margin opposite the end of the marginal vein (fig. 75). Cilia of disk, dense, short; noticeably coarser under marginal vein. Marginal fringe short. Marginal vein plainly longer than submarginal; postmarginal shortly produced; stigmal as shown in Figure 112.

Scutellum wider than long (7:6), not quite so long as the mesoscutum. In tag mounts after shrinkage, the thorax from tegula to tegula is apparently unusually wide, especially in proportion to the abdomen. After shrinkage the abdomen appears narrower than the thorax and not quite as long; about one and one-fourth times as long as wide. Figure 13 is more or less diagrammatic and does not give

an accurate picture of the abdomen after shrinkage. Seventh tergite short, strongly transverse. Ovipositor not exserted.

Frontovertex with scattered, rather coarse, short black setae, those on face and cheeks much finer. Eyes microscopically pubescent. Mesoscutum with numerous rather coarse, short, black setae. Each parapsis with four, strong, black setae. Middle tibiae at base with five strong, black setae, apex of femora with a strong seta beneath.

Measurements in mm.: Length of average sized specimen 1.3. Scape 0.20 long by 0.0392 wide. Pedicel 0.0664 long by 0.0408 wide. First funicle joint 0.1184 long by 0.0592 wide; second 0.0880 long by 0.0656 wide; third 0.0824 long by 0.0736 wide. First club joint 0.0776 long by 0.0760 wide; second 0.0760 long by 0.0704 wide; third 0.0696 long by 0.0480 wide. Marginal vein 0.40 long; submarginal 34 long.

Redescribed from type specimens. This species was reared by Rust, October 21, 1925, from *Saissetia oleae* (Bernard) infesting *Chaetachme aristata*, "Unkawoti trees," at Durban, Natal, South Africa, and from the same host collected at Pretoria, Transvaal September 1, 1919.

8. COCCOPHAGUS FLAVESCENS Howard

Plate 7, Figure 22; Plate 11, Figure 135

Coccophagus flavescens HOWARD, Proc. U. S. Nat. Mus., vol. 18, 1896, p. 634.—MERCET, Trab. Mus. Cienc. Nat. No. 10, 1912, pp. 227–28.

An elongated species; the habitus somewhat different from most species but this may be due to shriveling. Predominantly yellow with dark markings. Fore wings generally infuscated.

Female.—General color yellow, marked as follows: Center of pronotum blackish; sides of propodeum tinged with fuscous; dorsum of abdomen on apical three-fourths brown, setae of thorax dusky. Antennae yellow, sensoria fuscous. Legs yellow.

Antennae unusually long. Pedicel almost twice as long as wide but shorter than the first funicle joint. First funicle joint longest, almost three times as long as wide; second and third successively shorter, the latter not quite twice as long as wide. Club well separated from the funicle, the basal joint almost as long and plainly wider than the preceding funicle joint. By actual measurement the second club joint a trifle the shortest, but to the eye the club joints appear of about equal length (fig. 22).

Scutellum plainly wider than long but not strongly transverse. Mesoscutum apparently comparatively short, not much if any longer than the scutellum. Abdomen almost twice as long as wide and longer than the thorax.

Mesoscutum moderately setose. Each axilla with two rather strong, black setae; each parapsis with three or four similar setae.

Fore wings slightly but plainly infuscated and finely and densely ciliated. Marginal vein longer than the submarginal; stigmal shown in Figure 135.

Measurements in mm.: Length 1.10. Scape 0.1480 long by 0.0312 wide. Pedicel 0.0520 long by 0.0280 wide. First funicle joint 0.0712 long by 0.0296 wide; second 0.0648 long by 0.0296 wide; third 0.0584 long by 0.0368 wide. First club joint 0.0560 long by 0.0440 wide; second 0.0488 long by 0.0424 wide; third 0.0520 long by 0.0360 wide. Fore wings 0.84 long by 0.38 wide. Marginal vein 0.31 long; submarginal 0.25 long.

Male.—Unlike the female in coloration and structure. Head and body black, lateral and ventral parts faintly brownish. Scape pale yellow in contrast to the brownish pedicel; flagellum appearing blackish due to the numerous sensoria. Apex of fore and middle femora pale and the latter with an annulus at base. Fore tibiae mostly dirty white; middle tibiae dirty white on apical one-third. So far as can be seen all tarsi whitish.

Antennae unlike that of the female. Pedicel short, about as long as wide and much shorter than the first funicle joint. Funicle joints all slightly increase in width and probably slightly decrease in length distad, but to the eye they appear subequal in length. First funicle joint probably a trifle more than one and one-half times as long as wide; third probably a trifle less than one and one-half times as long as wide. Club slightly wider than the funicle. The male antenna is quite different from that of the female yet it is not unlike the antennae of many different species.

Habitus of the male unlike that of the female; thorax longer and abdomen much smaller; vestiture also different and the mesothorax is finely reticulated. Mesoscutum longer than scutellum and rather sparsely setose, there being only two setae on the posterior margin. Scutellum proportionately longer than that of the female, by measurement about as long as wide, but to the eye appearing longer than wide. Scutellum with three pairs of bristles in longitudinal alignment, apical pair the longest.

Fore wings crumpled and glued over the abdomen and not suitable for study.

Length 0.9 mm.

Redescribed from one female and one male (cotypes), U.S.N.M. No. 3249. Labeled "par. on *Lecanium coffeae*, Punduloya, Ceylon, E. E. Green" (?).[24]

[24] *Lecanium coffeae* Signoret is given as a synonym of *Saissetia hemisphaerica* (Targioni) in Fernald's catalogue.

9. COCCOPHAGUS PERHISPIDIS Girault

Plate 7, Figure 23; Plate 11, Figure 97

Coccophagus perhispidis GIRAULT, New Pests from Australia, III. Brisbane, Queensland, August 25, 1926. (Published by author.)

Girault's original description follows: "As *triguttatus* but only pronotum widely across middle and a mark behind insertion of the wings, black: Upper thorax with coarse black setae but axillae with only pair moderate bristles. Nelson, jungle."

Of the type, only the head, fragments of the legs, and a portion of the wings remain. The head is badly crushed and partly protruding under the edge of the cover glass in an excess of balsam.

The antennae are in fragments and partially obscured. The antenna shown in Figure 23 is in part hypothetical. Scape appears unusually wide but this may be due to crushing. Pedicel slightly longer than wide. First funicle joint longest, the following successively shorter; all of about the same width. Club about as long as the first and second funicle joints united and not much wider than the funicle. Funicle and club furnished with numerous sensoria that extend the entire length of the segments.

Fore wings with the disk densely and uniformly ciliated. Marginal fringe of average length. Postmarginal and stigmal veins as shown in Figure 97.

Mandibles almost edentate.

All fragments of the type remaining on slide light yellow.

Middle tibial spur just a trifle shorter than the basitarsus; basitarsus not quite as long as the succeeding joints united.

Measurements in mm.: Fore wing 0.36 wide. Marginal vein 0.28 long. Marginal fringe 0.0224 long. Five tarsal joints of the middle legs united 0.24; basitarsus 0.1080 long; tibial spur 0.0916 long. Scape 0.1240 long by 0.0496 wide. Pedicel 0.0464 long by 0.0416 wide. First funicle joint 0.0824 long by 0.0408 wide; second 0.0640 long by 0.0440 wide; third 0.0464 long by 0.0416 wide. First club joint 0.0472 long by 0.0496 wide; second 0.0432 long by 0.512 wide; third 0.0432 long by 0.0368 wide. The club of the second antenna, which remains on the slide, gave the following set of measurements: First club joint 0.0448 long by 0.0560 wide; second 0.0448 long by 0.0560 wide; third 0.424 long by 0.440 wide.

Redescribed from the fragments of the type female in the Queensland Museum. No data on slide other than name and designation type.

10. COCCOPHAGUS GURNEYI Compere

Plate 4, Figure 5; Plate 7, Figure 24

Cocophagus gurneyi COMPERE, Univ. Calif. Publ Ent., vol. 5, No. 1, 1929, pp. 1–3, 2 figures in text.

This distinctive species has recently been adequately described and figured. It is one of the few species parasitic on *Pseudococcus* spp. This species was introduced into California from Sydney, New South Wales, where it was discovered parasitizing *Pseudococcus gahani* Green and *Pseudococcus longispinus* (Targioni). It is now established in southern California and in the San Francisco Bay region.

11. COCCOPHAGUS TARONGAENSIS, new species

Plate 7, Figure 25; Plate 11, Figure 95; Plate 12, Figure 140; Plate 13, Figure 151; Plate 14, Figure 173

A medium sized, robust species, yellow and black, with sparse, very fine setae on the mesoscutum and three pairs of short, delicate setae on the scutellum. This species is closely allied to *C. leptospermi* Girault and is best separated from the latter by the finer, sparser setae of the mesoscutum, by a difference in the arrangement of the cilia at the base of the fore wings and by coloration.

Female.—Head predominantly yellow; ocellar area blotched with brown or black; in some specimens, upper part of scrobes brown or black; occiput on either side of foramen black or brown. Antennae yellow with brownish sensoria. Thorax predominantly yellow: collar of pronotum, anterior margin of mesoscutum, a rounded spot on either parapsis, most of axillae, anterior margin of scutellum, metanotum except median part, propodeum except lateral of spiracles, blackish. Abdomen mostly black above; sides of sixth tergite and seventh tergite except cercal plates, yellow. Venter of abdomen yellow. Legs yellow, the tibiae and tarsi obscurely brownish. Wing veins pale white.

Pedicel about one and one-half times as long as wide and only a trifle shorter than the first funicle joint. First funicle joint the longest, about twice as long as wide, plainly narrower than the succeeding joint; second about one and one-third times as long as wide, third about as wide as long and twice as wide as the first. Club as long as second and third and one-half of the first funicle joints (fig. 25).

Mandibles as shown in Figure 173.

Fore wings hyaline; cilia of disk fine and short, rather dense. A hairless streak from the base of the marginal vein projects obliquely basad and is separated from the basal hairless streak by five rows of cilia. Basal hairless streak well developed, its distal portion extending obliquely outward. Marginal fringe short. Mar-

ginal vein plainly shorter than the submarginal. Postmarginal vein distinct, shortly produced. Stigmal vein shown in figure 95.

Scutellum large, slightly wider than long (13:10) and as long as the mesoscutum. Ovipostor sheaths not reaching the apex of abdomen (fig. 140).

Scutellum furnished with three pairs of small setae comparable in size to those of the mesoscutum. Mesoscutum sparsely setose, the setae very small and inconspicuous. Small setae on sides of first four tergites; on the fifth and sixth tergites the setae form a complete row across the dorsum; seventh tergite with longer and paler setae at the apex.

Basitarsus of middle legs almost as long as the succeeding joints united; tibial spur about two-thirds as long as the basitarsus.

Length 1.1 mm.

Male.—Yellow and black to brown. Head colored like that of female. Pronotum blackish, the sides yellow. Mesoscutum on either side with a wide band of yellow, the disk occupied by a blackish V-shaped area. Parapsides with a rounded, dark blotch anteriorly, remainder yellow. Axillae entirely blackish. Meson of scutellum with a broad, longitudinal blackish blotch, which in some specimens is more or less V-shaped. Median part of metanotum pale yellow, remainder of metanotum and propodeum blackish. Abdomen blackish above; seventh tergite suffused with yellow. Sides and under parts of thorax and abdomen yellow. Legs yellow, tarsi of fore legs and apical joints of middle and hind legs fuscous. Wing veins pale white.

Antennae shown in Figure 151.

Type.—Cat. No. 42102, U.S.N.M.

Described from 10 females and 2 males (holotype, allotype, and paratypes) reared from *Inglisia* species, Taronga Zoological Park, Sydney, New South Wales, October 28, 1927, collected by H. Compere.

12. COCCOPHAGUS SIGNUS Girault

Plate 7, Figure 26; Plate 10, Figure 85; Plate 11, Figure 120

Coccophagus signus GIRAULT, Insecutor Inscitiae Menstruus, vol. 8, 1920, p. 45.

Girault's original description follows: "Like the robust purple species. Purple, wings clear, scutellum, postscutellum, scape, and legs save first two pairs, coxae, base of first femora, lemon. Mouth orange. Scutellum naked, with four setae in a rectangle (wider than long). Meringa, on a window, female."

The type female is fairly well preserved, the head detached from body. It is almost impossible to determine the original body color. So far as can be seen the legs are light yellow and the head and body brownish, or blackish in part suffused with yellow. It apparently belongs to the group of *Coccophagus* related to *C. rusti* Compere.

This is a medium sized species with a large scutellum furnished with three pairs of strong bristles. Mesoscutum with strong setae. Eyes distinctly hairy.

Mesoscutum and axillae rather coarsely reticulated. Metanotum with striae on sides. Propodeum with a strong sublateral carina on either side.

Pedicel plainly longer than wide and more than one-half as long as the first funicle joint. First funicle joint the longest, about twice as long as wide; succeeding two joints successively shorter; all almost imperceptibly increase in width distad; third about one and one-third times as long as wide. Club slightly wider than the funicle and not so long as the funicle joints united (fig. 26).

Fore wings probably slightly infuscated, at least under the veins. Disk of wing clothed with rather coarse and abundant cilia. Arrangement of cilia at base of fore wing shown in Figure 85. Marginal vein slightly longer than the submarginal. Detail of stigmal and postmarginal veins as shown in Figure 120. Postmarginal vein developed a trifle more than usual.

Abdomen small, shorter than the thorax. Ovipositor hardly exserted.

Basitarsus of middle legs about as long as the succeeding three joints united; tibial spur slightly shorter than the basitarsus.

Measurements in mm.; length of body, head excluded, 0.92. Abdomen 0.44 long. Scutellum 0.16 long by 0.2256 wide. Fore wings 0.76 long by 0.34 wide. Marginal vein 0.02696 long; submarginal 0.20 long. Marginal fringe 0.0160 long. Scape 0.1320 long by 0.03136 wide. Pedicel 0.0464 long by 0.0352 wide: First funicle joint 0.0744 long by 0.0368 wide; second 0.0640 long by 0.0424 wide; third 0.060 long by 0.0464 wide. First club joint 0.0560 long by 0.0480 wide; second 0.0464 long by 0.0464 wide; third 0.0496 long by 0.0384 wide. Five tarsal joints of middle legs united 0.28 long; basitarsus 0.1344 long; tibial spur 0.1008 long.

Redescribed from type female in the Queensland Museum. No data on slide other than name and "Queensland Museum." Not designated as type specimen on slide label.

13. COCCOPHAGUS MARIFORMIS, new species

Plate 7, Figure 27; Plate 11, Figure 114; Plate 13, Figure 148

The arrangement of the cilia on the basal part of the fore wing, the male-like character of the antennal sensoria, and the enlarged stigmal vein are good characters for the recognition of this species.

Female.—Head mostly orange yellow; face marked with iridescent pearly white; occiput blotched with fuscous. Antennae yellow; outer side of scape pearly white, the dorsal margin dusky. Thorax orange yellow except as follows: pronotum, anterior mar-

gin of mesoscutum, propodeum, proepisterna, ventral part of prepectus, mesosternum, and mesoepisterna varying from blackish to brownish. Median part of metanotum pale yellow. Axillae slightly brownish. Tegulae spotted with fuscous. Eyes and ocelli vermilion. Wing veins pale yellow. Abdomen black to brownish. Legs pale yellow except for the middle and hind coxae which are more or less suffused with blackish.

The antennae offer the best character for the recognition of this species. The funicle joints are articulated ventrally and the ventral part of each joint is produced further distad than the dorsal part. The sensoria are characteristic; on each funicle joint, in lateral view, five or more sensoria are visible extending the entire length of the joints on which they occur. In appearance the antennae is not unlike that of a male *Prococcophagus*. Scape slightly wider than usual, about four times as long as wide. Pedicel one and one-half times as long as wide, slightly but appreciably shorter than the first funicle joint. Funicle joints all subequal, slightly less than one and one-half times as long as wide. Club not markedly different from the funicle, hardly any wider and with similar sensoria (fig. 27).

The two females available for study are poorly mounted and a satisfactory view of the mandibles can not be had. Apparently mandibles sharply tridentate.

Fore wings hyaline; an oblique hairless streak cut off from the basal hairless streak by three rows of cilia; the oblique hairless streak continuous with the hairless streak beneath the marginal vein. Cilia of disk moderately coarse and sparse. Marginal fringe moderately long. Submarginal vein only a trifle longer than the marginal, the difference hardly appreciable without actual measurement. Postmarginal vein distinct, well developed, but not produced so far distad as the stigmal vein; stigmal vein with a slender neck and widely expanded knob (fig. 114).

Frontovertex with slender, scattered black setae. Mesoscutum with rather sparse, slender, black setae, those arranged along the lateral and posterior margins much longer. Each parapsis with three rather long, slender, black setae. The setae of the axillae are distinctive; anteriorly there are two setae about as long as those on the disk of the mesoscutum and posteriorly a much stronger setae comparable in length to the anterior pair of scutellar bristles. Scutellum with three pairs of long, slender bristles, the anterior pair a trifle closer together than the median and apical pairs that are in longitudinal alignment. The three pairs of scutellar bristles subequal in length, the apical pair thickest. Setae on the tergites rather long and slender; on the fifth, sixth, and seventh tergites arranged across the dorsum.

Basitarsus of middle legs about as long as the succeeding three joints united; tibial spur a trifle shorter than the basitarsus.

This species has several structural aberrations. The prominent median part of the metanotum is separated from the scutellum by a distance equal to its own length and is not contiguous to the scutellum as usual. The scutellum is slightly more rounded than usual; almost one and one-half times as long as wide (24:17 and plainly shorter than the mesoscutum. Abdomen rather slender toward the apex.

Length 1.3 mm.

Male.—Frontovertex orange yellow; face iridescent pearly white; cheeks yellow with a suffusion of brownish; occiput blackish. Pronotum blackish. Mesoscutum broadly brownish orange laterally and posteriorly, the center with V-shaped blackish area. Parapsides yellow, suffused with fuscous on the expanded part. Axillae black. Scutellum blackish brown with an irregular median longitudinal stripe that expands anteriorly and posteriorly. Tegulae yellow with a dusky suffusion. Median part of metanotum light lemon yellow. The following parts blackish: propodeum, abdomen, ventral and lateral parts of thorax. Hind coxae blackish, fore and middle coxae blackish at base, pale toward the apex. Apical tarsal joints of middle and hind legs fuscous, all fore tarsi slightly dusky, remainder of legs mostly light yellow.

Antenna as shown in Figure 148.

Length 1.3 mm.

Type.—Cat. No. 42095, U.S.N.M.

Described from two females and one male (holotype, allotype, and paratype) mounted in balsam and slightly pressed. Two females reared by E. W. Rust from *Baccacoccus* species collected at Signal Hill, Cape Town, South Africa, February 6, 7, 1925; male obtained from the same locality by Rust on February 10, 1925, but the slide label does not give a host. Rust's No. M–3.

14. COCCOPHAGUS EMERSONI Girault

Plate 11, Figure 116

Coccophagus emersoni GIRAULT, Insecutor Inscitiae Menstruus, vol. 5, 1917, pp. 29–30.

A moderately small species. The coloration as described by Girault is no longer discernible, the orange having faded so that parts originally described as orange now appear yellowish. The derm on the yellowed portions of the mesoscutum and scutellum is semitranslucent. Parts of the antennae are missing in the paratype examined.

Female.—The following parts black: pronotum, anterior part of mesoscutum, a spot on either parapsis, axillae, metanotum except

median part, propodeum, abdomen, most of thoracic sternites and pleurites, and hind coxae. Sternites in proximity to roots of wings more or less yellowish. Dorsum of head distinctly orange with the ocellar area blackish; face and cheeks yellow. Mesoscutum except anteriorly, parapsides except spots, entire scutellum, and median part of metanotum yellow. Legs yellow, except the dark hind coxae; fore legs faintly brownish. Scape yellow, concolorous with face; flagellum dark brown.

Pedicel longer than wide and plainly shorter than the first funicle joint. First funicle joint longest, not quite twice as long as wide. According to Girault: "Club distinct but not much wider than the funicle; funicle three a little longer than wide; one nearly twice longer than wide; pedicel barely as long as funicle three, subequal to club two; all club joints wider than long." Funicle and club with numerous dark sensoria.

Fore wings hyaline or subhyaline, finely and densely ciliated. Posterior basal hairless streak well developed, bending upward at its distal end. Submarginal vein plainly longer than marginal. Stigmal and postmarginal veings as shown in Figure 116.

Scutellum plainly wider than long (11:8) but not strongly transverse, and shorter than the mesoscutum (8:12). Abdomen not much longer than wide (16:15) and shorter than the thorax. Ovipositor not exserted. Median part of metanotum large.

Scutellum with three pairs of rather small bristles. Mesoscutum with rather numerous small setae. Each axilla with two setae about as large as those of the mesoscutum.

The yellow parts of the mesoscutum and scutellum with distinct areolate reticulations.

Middle tibial spur plainly shorter than the basitarsus.

Length 1.1 mm.

Redescribed from one female (paratype), U.S.N.M. No. 20684. West Australia, George Compere, Coll.

15. COCCOPHAGUS FLAVICEPS, new species

Plate 6, Figure 11; Plate 7, Figure 28; Plate 11, Figure 126; Plate 14, Figure 170

This species is readily separable from the described African forms by the hyaline wings, three pairs of bristles on the scutellum, elongated seventh tergite, conformation of the antennae, and distinctive coloration.

Female.—General color of the body black. Head lemon yellow, except the upper half of the occiput which is black, and the dorsum which becomes fuscous in proximity to the ocelli. Flagellum black; scape yellow except toward the apex on dorsal margin which is blackish. Mesoscutum black marked with a variable amount of

orange. In some specimens the orange color forms a small elongated blotch or streak posteriorly on either lateral margin; other specimens have the mesoscutum more extensively orange colored, the pattern arranged so that the blackened portion is in the shape of a V. Scutellum mostly, if not entirely, orange colored, sometimes the base very narrowly black. Median part of metanotum yellow. Parapsides orange and black. Legs mostly lemon yellow; basal half of hind tibiae and somewhat more than the basal half of hind coxae black; middle coxae touched beneath with black; apical two or three tarsi of hind legs fuscous; apical tarsi of middle legs fuscous; all tarsi of fore legs faintly fuscous. Tibiae not pure lemon yellow like the femora but with a faint suffusion of brownish.

Pedicel small, hardly longer than wide and about one-third as long as the first funicle joint. First funicle joint plainly the longest, more than twice as long as wide; second and third joints each plainly shorter than the preceding, the third about two-thirds the length of the first. Club about as long as the first two funicle joints combined and not much wider than the funicle. Funicle and club furnished with numerous sensoria which on the third funicle joint and on club joints extend the entire length of the segments; sensoria on the first two funicle joints approximately one-half as long as the segment on which they occur (fig. 28).

Mandibles with one small ventral tooth and a broad, dorsal truncation (fig. 170).

Fore wings hyaline. Marginal vein about as long as the submarginal vein; stigmal vein as shown in Figure 126. Disk of wing with abundant small cilia. Marginal fringe very short.

Scutellum convex, slightly wider than long (24:21) and not quite so long as the mesoscutum (21:22). Abdomen about as long as the thorax; seventh tergite long. Ovipositor shortly exserted. In dried specimens the abdomen is strongly laterally compressed. Thorax and abdomen as shown in Figure 11.

Basitarsus of middle legs not quite as long as the succeeding joints united; tibial spur slightly shorter than the basitarsus. Paired spurs of hind tibiae plainly of unequal length.

Mesoscutum densely setose. Scutellum with three pairs of strong, black bristles. Each parapsis with three setae about as strong as those of the mesoscutum. Each axilla with two setae somewhat stronger than those of mesoscutum. The transverse rows of setae on the abdomen incomplete on the dorsum of the first, second, and third tergites.

Measurements in mm.: Length 1.1. Scape 0.1464 long by 0.04 wide. Pedicel 0.0456 long by 0.0440 wide. First funicle joint 0.1240 long by 0.0584 wide; second 0.0984 long by 0.0504 wide; third 0.08

long by 0.0552 wide. First club joint 0.0704 long by 0.0592 wide; second 0.08 long by 0.0576 wide; third 0.0704 long by 0.0432 wide.

Type.—Cat. No. 42098, U.S.N.M.

Described from 12 females (holotype and paratypes) received from E. W. Rust with the following data: "Reared only twice since I have been here (Natal); first from *Ceroplastes* n. sp. on custard apple, *Anona cherimolia* (*A. cherimoya?*), taken at Congella, Natal, March 18, 1926, and later from *Ceroplastes destructor* on a wild plant, Durban, August 16, 1926." Rust's No. C–19.

16. COCCOPHAGUS TSCHIRCHII Mahdihassan

Plate 7, Figure 29; Plate 11, Figure 109

Coccophagus tschirchii MAHDIHASSAN, Journ. Sci. Assoc., Maharajah's Coll., India, vol. 1, 1923, p. 82.—FERRIÈRE, Bull. Ent. Res., vol. 19, pt. 2, Oct. 1928, pp. 173–74, fig. 2.

This striking species was recognized and adequately described by Ch. Ferrière.

Female.—Head and thorax yellow except for blackish or brownish markings as follows: occiput on either side of foramen; center and the exposed dorsal part of pronotum; anterior part of mesoscutum with a rounded U-shaped blotch; wedge shaped base of parapsides and a median spot; axillae suffused; sides of metanotum, median part of propodeum between the carinae; petiole; tegulae; a part of mesosternum. Abdomen entirely black. Legs entirely yellow. Eyes and ocelli reddish.

Mandibles plainly tridentate.

Abdomen short, rounded.

Antennae as shown in Figure 29.

Stigmal vein as shown in Figure 109.

Redescribed from a series of specimens loaned by the Imperial Bureau of Entomology that were determined by Ch. Ferrière and labeled: "India, Bengal, Kuudari, 1927, C. S. Misra. Ex. Lac insect on *Butea frondosa.*" This species was first reared by Mahdihassan from the Mysore lac insect.

17. COCCOPHAGUS GREGARIUS, new species

Plate 7, Figure 30; Plate 13, Figure 149; Plate 14, Figure 183.

A medium sized, robust species, black with yellow markings. The pedicel which is about as wide as long is a character that readily separates this species from the great majority of *Coccophagus.*

Female.—Head yellow except for the ocellar area and concealed part of the occiput which are blackish. Antennae mostly yellow, a part of scape and of pedical slightly dusky; sensoria fuscous. Pronotum and proepisternum black. Mesoscutum black with a band of yellow on either side. Parapsides yellow with a black spot on the expanded part. Axillae black. Scutellum black, yellow laterally.

Tegulae yellow. Metanotum, propodeum, and abdomen black. Prosternum yellowish. Prepectus yellow with more or less blackish suffusions. Mesoepisternum mostly black. Metapleura black. Hind coxae mostly black, their apices yellow; apical tarsal joints fuscous, remainder of legs yellow with faint traces of dusky in parts.

Antennae somewhat thicker than usual. Pedicel short, as wide as long and one-half as long as the first funicle joint. First funicle joint the longest, not quite twice as long as wide; second and third successively slightly increasing in width and decreasing in length, the latter only slightly longer than wide. First club joint slightly wider than long and not quite as long as the third funicle joint; second like the first; third as long as wide (fig. 30).

Mandibles as shown in Figure 183.

Fore wings hyaline; cilia fine and short; a well developed basal hairless streak extending obliquely distad. Marginal fringe short. Marginal vein appreciably shorter than the submarginal.

Scutellum large, slightly wider than long (1:10) and not quite as long as the mesoscutum. Ovipositor short, not reaching to the apex of abdomen.

The setae on the thorax are small and inconspicuous yet easily detected on tag-mounted specimens. In cleared balsam-mounted specimens, three setae are plainly seen on the anterior margin of each axilla in the majority of specimens; in a few specimens only two setae occur.

Basitarsus of the middle legs about as long as the succeeding joints united; tibial spur plainly shorter than the basitarsus.

Length 1.2 mm.

Male.—Very similar to the female except for sexual differences, antennal differences, and more extensive blackish coloration, especially on the mesoscutum. Antenna as shown in Figure 149.

Type.—Cat. No. 42101, U.S.N.M.

Described from 35 females and 20 males (holotype, allotype, and paratypes) reared from *Eriococcus* species on *Acacia*, Taronga Zoological Park, Sydney, New South Wales, collected by H. Compere, October 19, 1927. In addition to the type specimens about 1000 individuals were obtained from *Ericoccus* that infested several small twigs. The large scales were densely packed with the *Coccophagus*, each scale containing a great number of parasites. Scales from which the parasites issued were perforated with from 10 to 25 exit holes.

18. COCCOPHAGUS JAVENSIS Girault

Plate 7, Figure 31; Plate 10, Figure 80; Plate 11, Figure 111; Plate 12, Figure 144; Plate 14, Figure 182

Coccophagus javensis GIRAULT, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 482–83.

The cotypes are mounted in balsam and slightly crushed. It is now impossible to determine the exact coloration. The habitus of this species is similar to that of *C. ochraceus* Howard, but a careful examination shows that it is not so closely related as a first glance indicates. Apparently the mandibles are sharply tridentate, more like those of *C. zebratus* Howard than they are like those of *C. ochraceus*. Also, unlike many of the small yellow species, this form has the pedicel smaller than the first funicle joint. Because of fading, the following color description may be misleading to the extent that, in life, the yellow coloration may be of different shades.

Female.—General color yellow (perhaps ochraceous), with dark brown or blackish markings as follows: upper part of occiput; center of pronotum; anterior margin of mesoscutum on the meson; sides of metanotum; center of propodeum; a broad, transverse band across the middle of abdomen. Legs and antennae yellow.

Pedicel about one and one-third times as long as wide and slightly but appreciably shorter than the first funicle joint. The funicle joints appear subequal to the eye, but measurements show that they increase very slightly in length distad. First club joint about as long as the preceding funicle joint; second and third each slightly decrease in length. Funicle and club with more abundant sensoria than usual for the small yellow species as shown in Figure 31.

Mandibles plainly tridentate as shown in Figure 182.

Scutellum rather large, wider than long (19:15) and not quite as long as the mesoscutum (15:16) as shown in Figure 144. Abdomen of almost uniform width for the greater part, broadly rounded at apex; cercal plates large; ovipositor sheaths shortly protruded.

Frontovertex with abundant, fine, dark setae. Eyes distinctly hairy. Mesoscutum with sparse, rather strong, dark setae. Each parapsis with four or five setae similar in size to those two on each axilla. Tergites with some moderately strong setae, but because of shrinkage their positions can not be determined.

Sides of metanotum with intricate striae and faint reticulations. Mesothorax without visible sculpture.

Basitarsus of middle legs about as long as the three succeeding joints united; tibial spur slightly shorter than the basitarsus. Paired spurs at apex of hind tibiae very unequal.

Fore wings hyaline, broad, a trifle more than twice as long as wide; disk with moderately coarse cilia; a small narrow hairless area beneath basal half of marginal vein, separated by about three rows of cilia from another hairless area extending to base of wing

as shown in Figure 80. Marginal vein slightly longer than the submarginal; postmarginal shortly produced as shown in Figure 111.

Length 0.8 mm.

Redescribed from five females (cotypes U. S. N. M. No. 19894). According to the original description this species was reared from a *Pseudococcus* species on wild *Mangifera*, Salatiga, Java, by P. Van der Goot.

19. COCCOPHAGUS TRIGUTTATUS Girault

Plate 7, Figure 32; Plate 11, Figure 103; Plate 12, Figure 145

Coccophagus triguttatus GIRAULT, Memoirs Queensland Museum, vol. 4, 1915, pp. 48–49.

Fortunately the type of this species is in good condition, the body being bulged only because of pressure. The head is detached from the body and the remnants of a second head are present. In his description, Girault compares *C. perhispidis* Girault, *C. pulcini* Girault, and *C. triangulatinotus* Girault to this species, also *C. inkermani* Girault is said to follow *perhispidis*. Girault states that this species differs from the generic diagnosis in bearing a very short ring joint and in having the hind tibial spurs double. So far as I know all the species of *Coccophagus* possess a ring joint and double hind tibial spurs. The species of *Coccophagus* of the *triguttatus* group seem to be intermediate between those of the *ochraceus* group, characterized by a strongly transverse scutellum, and typical species having the scutellum almost as long as wide.

Girault's color description is at follows: "Intense golden yellow (greenish yellow), the wings hyaline, the antennae and legs concolorous. On the distal half of the abdomen, three conspicuous round black spots from dorsal aspect arranged in a triangle, the apical one at tip, the basal two at lateral margin, one on each side just beyond proximal half (sometimes if the segments are stretched, split transversely into two more or less rectangular spots); a small triangular spot at apex (cephalad) of each axilla, also jet black, as well as the cephalic margin of scutellum between the parasidal furrow ends. Base of fore wings very slightly dusky and a curved, narrow, black line down propodeum on each side near margin." The dusky coloration of the fore wings is no longer evident even though one wing is clearly visible. The center of the pronotum is black.

Pedicel longer than wide and shorter than the first funicle joint. First funicle joint plainly the longest, a trifle more than twice as long as wide; second and third each successively shorter and wider; third slightly longer than wide. Club slightly longer than first and second funicle joints united and about one and one-third times as wide as the third funicle joint (fig. 32).

Scutellum plainly wider than long but not strongly transverse (fig. 145). Axillae large, apparently not closely fused with the scutellum. Mesoscutum plainly longer than the scutellum (Mesopleura bulged outward in the types). Scutellum at apex rather broadly truncate. Median piece of metanotum distinct. Propodeum widely expanded with distinct longitudinal carinae. Spiracles reniform. Abdomen slightly longer than wide but not quite as long as the thorax. As seen through the derm, ovipositor arises near the middle and is very shortly exserted. (The exsertion of the ovipositor may be due to crushing.)

The setae of the body are now transparent and can only be seen with difficulty under high magnification. Mesoscutum moderately, densely setose, the setae arranged along the lateral and posterior margin apparently stronger than elsewhere. Each axilla with two setae. A wing is folded over the scutellum obscuring it, but the anterior pair of bristles can be detected and without much doubt a median and apical pair are also present (fig. 145).

Mandibles with an acute ventral tooth and a dorsal tooth broadly concave along the margin.

Fore wings large and furnished with abundant cilia of moderate size. Marginal vein as long as the submarginal; stigmal and postmarginal as shown in Figure 103.

Basitarsus of the middle legs as long as the succeeding four joints united; tibial spur a trifle shorter than the basitarsus; plantar surface of the tarsi with numerous peg-shaped spines.

Measurements in mm.: Girault gives the total length as 1.0. The specimen studied measures 1.02 from the pronotum to the apex of abdomen. Mesoscutum 0.2520 long. Scutellum 0.1704 long by 0.2248 wide. Thorax 0.56 long. Abdomen 0.48 long by 0.40 wide. Fore wing 0.92 long by 0.420 wide. Marginal vein 0.28 long; submarginal 0.28 long. Marginal fringe 0.0168 long. Tarsi of middle legs 0.30 long; basitarsus 0.1544 long; tibial spur 0.1296 long. Scape 0.1336 long by 0.03136 wide. Pedicel 0.0488 long by 0.0304 wide. First funicle joint 0.0616 long by 0.0296 wide; second 0.0432 long by 0.0304 wide; third 0.0408 long by 0.0304 wide. First club joint 0.0440 long by 0.0512 wide; second 0.0288 long by 0.0488 wide; third 0.0256 long by 0.0376 wide.

Redescribed from one female and an additional head marked "type" in the Queensland Museum. Girault, in his description gives data as follows: "Described from five females reared in connection with a cecidomyiid gall on the stem of a young *Eucalyptus corymbosa* (Bloodwood) but which was infested with unarmored coccids. November 13, 1913 (A. P. Dodd). Habitat: Northern Queensland (Gordonvale near Cairns). Types: No. Hy/2926 Queensland Museum, Brisbane, the above specimen on a slide."

20. COCCOPHAGUS SPECIALIS, new species

Plate 7, Figure 33

This unusual species has the habitus of *Euxanthellus*. Wings, hyaline, the cilia translucent and abnormally long and dense basally. Predominantly yellow. Abdomen on either side with two longitudinal rows of brown dots, which on the outer rows coalesce or are contiguous so as to form a more or less continuous stripe. First funicle joint about three times as long as wide.

Female.—Face and cheeks white, in life probably iridescent pearly white. Frontovertex orange blotched with iridescent pearly white contiguous to the ocelli. Eyes and ocelli reddish. Center of occiput and a transverse band on either side of the foramen blackish. Concealed part of pronotum and a spot on either posterior angle blackish. Thorax lemon yellow; propodeum near spiracles iridescent pearly white. Middle of abdomen on dorsum more or less yellowish, the sides widely marked with iridescent pearly white interrupted by elongated brownish spots. Legs pale yellowish; first and second tarsal joints of hind legs fuscous, those of the middle legs slightly fuscous; remaining tarsi of middle and hind legs yellow to whitish; first three or four tarsal joints of fore legs more or less faintly fuscous, apical joints pale, claws fuscous.

The antennae are mounted so that the scape can not be accurately viewed but apparently the scape is longer than usual. Pedicel almost twice as long as wide, plainly shorter than the first funicle joint. First funicle joint plainly the longest, about three times as long as wide; second and third successively decrease in length and slightly increase in width so that the third is about one and one-half times as long as wide. Club large, all joints a trifle longer than wide (fig. 33).

Fore wings clothed with translucent, "silky" cilia. Marginal vein as long as the submarginal; postmarginal produced as far distad as the apex of stigmal. Wing veins pale.

Frontovertex slightly wider than long (8:7) and one-half as wide as the head (8:16). Head plainly much wider than the mesoscutum (16:11). Mesoscutum moderately long. Scutellum wider than long (8:6) and shorter than the mesoscutum (6:8). Scutellum squarely truncate at apex; somewhat hexagonal. Median piece of metanotum, distinct, well developed appearing like an apical part of scutellum separated by a broad cross suture. Like *C. triguttatus* Girault, this species presents conspicuous bulged mesopleura that are translucent showing the transverse striae. Abdomen plainly shorter than the thorax, slightly wider than long (32:27), the lateral curvatures from base to apex almost uniform; as seen through the derm the ovipositor arises under the posterior margin of the third tergite and very slightly projects at the apex.

Frontovertex with fine dark setae that are not conspicuous. Mesoscutum with conspicuous, moderately strong, blackish setae, those along the sides not much, if any stronger than elsewhere; posterior margin with only two similar setae. Each parapsis with three setae about as strong as those on the mesoscutum and each axillae with two similar setae. Scutellum with three pairs of bristles, the median and apical pairs about twice as long as the mesoscutar setae, the anterior pair hardly any longer than the two setae on the posterior margin of the mesoscutum. The tergites seem to be bare, or if setae are present, they do not appear in an untreated specimen.

Basitarsus of middle legs about as long as the succeeding joints combined; tibial spur about as long as the basitarsus. Hind tibiae with one long apical spur paired with a short one.

Length 1.7 mm.

Male.—Face, cheeks, and antennae white. Frontovertex yellow; eyes and ocelli red. Occiput at sides and above foramen black. Concealed part of pronotum black; exposed sides of pronotum, sides and under parts of thorax, basal one-third of abdomen, and all of legs white. Propodeum between the spiracles, petiole, and dorsum of abdomen on last four tergites black to dark brown.

Pedicel small, wider than long. Club not differentiated from the funicle. Flagellum with numerous close set sensoria which are as long as the segment which they occupy.

Abdomen small, sides subparallel, almost truncate at apex. Head and thorax about the same size and proportions as that of the female. Since these male specimens are not appreciably pressed by the cover glass and present bulged mesopleura, this characteristic may be a normal development.

Length 1.4 mm.

Type.—Cat. No. 42085, U.S.N.M.

Described from two females and two males (holotype, allotype, and paratypes) on two slides mounted in balsam. Reared by E. W. Rust from *Saissetia oleae* (Bernard) collected at Durban, Natal, January 10, 1927.

21. COCCOPHAGUS TRIANGULATINOTUS Girault

Plate 7, Figure 34; Plate 11, Figure 119

Coccophagus triangulatinotus GIRAULT, New Pests from Australia, III, Brisbane, Queensland, August 25, 1926. (Published by author.) Insecutor Inscitiae Menstruus, vol. 14, Nos. 7–9, July–September, 1926, p. 133.

Girault's original description follows: "As *triguttatus* but marks on abdomen joined widely, basal two across, distal joined to this along meson. Dayboro forest, October 8, 1922."

The female type is partly obscured by some deposit on the insect. General color light yellow, liberally marked with blackish as fol-

lows: center of pronotum; anterior part of mesoscutum; axillae; scutellum in part (perhaps anteriorly); most of metanotum and propodeum; dorsum of abdomen except the first or first and second tergites and sides of the sixth or fifth and sixth tergites, which are yellow. Head, antennae, and legs yellow.

Scape and pedicel of both antennae concealed by the head. (Presumably, pedicel shorter than first funicle joint and longer than wide.) First funicle joint the longest; the succeeding progressively shorter and wider. Club about as long as the preceding two funicle joints combined and about one and one-half times as wide as the third funicle joint (fig. 34).

The outlines of the scutellum cannot be seen nor can the vestiture be studied; however, the size and shape of the surrounding parts indicate that the scutellum is not strongly transverse but almost as long as wide. It is also likely that the scutellum bears three pairs of bristles for if densely setose, some of the setae would likely be detected.

Fore wings relatively large and closely and densely ciliated. A hairless streak under the marginal vein is separated from a basal hairless streak by two rows of cilia. Hairless streaks of the wings somewhat similar in arrangement to those of *C. pulcini* Girault as shown in Figure 79. Marginal vein a trifle longer than the submarginal; stigmal and postmarginal as shown in Figure 119.

Basitarsus of middle legs almost as long as the four succeeding joints united; tibial spur slightly shorter than the basitarsus.

Measurements in mm.: Length of body (exclusive of head) 0.80. Fore wings 0.92 long by 0.46 wide. Marginal vein 0.30 long; submarginal 0.28 long. Marginal fringe 0.0192 long. Five tarsal joints of middle legs combined 0.28 long; basitarsus 0.12 long; tibial spur 0.1008 long. First funicle joint 0.0552 long by 0.0216 wide; second 0.0432 long by 0.0304 wide; third 0.0392 long by 0.0368 wide. First club joint 0.0408 long by 0.056 wide; second 0.0360 long by 0.0560 wide; third 0.0216 long by 0.0416 wide.

Redescribed from the female type, Queensland Museum. No. data on slide label other than name and designation "type female."

22. COCCOPHAGUS LEPTOSPERMI Girault

Plate 8, Figure 35; Plate 11, Figure 88; Plate 12, Figure 142; Plate 13, Figure 150; Plate 14, Figure 177

Coccophagus leptospermi GIRAULT, Insecutor Inscitiae Menstruus, vol. 5, 1917, p. 92.

So far as can be seen, structurally closely related to *C. triguttatus* Girault and *C. triangulatinotus* Girault; the detailed measurements and bulged mesopleura look suspiciously alike, yet on the basis of coloration, the three forms seem distinct. These three species of

small size and predominantly yellow coloration are at once distinguished from the other small yellow species by the antennae, which in this group have the pedicel smaller than the first funicle joint and the funicle joints decrease in length and slightly increase in width distad.

Female.—General color yellow; lateral and ventral parts of the thorax and the face and cheeks pale. Pronotum mostly blackish. Anterior margin of mesoscutum on meson more or less suffused with blackish. Sutures of scutellum and axillae anteriorly and the mesoscutum posteriorly vaguely suffused with blackish. Abdomen with five rather obscure dusky cross stripes, the first five tergites dusky on basal half. Eyes and ocelli reddish. Mandibles mostly brown. Fore tarsi entirely slightly brownish, and tarsi of other legs dusky apically; remainder of legs yellowish. Antennae yellow with brownish sensoria.

None of the antennae show the scape and pedicel clearly. Apparently the pedicel is about one and one-third times as long as wide and slightly shorter than the first funicle joint. First funicle joint plainly the longest, somewhat more than one and one-third times as long as wide; second and third successively slightly decreasing in length and slightly increasing in width. Club large, basal joint plainly larger than the third funicle joint; second as wide as the first and slightly shorter; third much the smallest (fig. 35).

Mandibles as shown in Figure 177.

Mesopleura prominent, bulged outward. Scutellum wider than long but not strongly transverse (11:8) and not quite as long as the mesoscutum (8:10). Abdomen not quite as long as the thorax, broadly rounded at apex; ovipositor as seen through the derm short, very slightly exerted beyond apex. Spiracles reniform. Median piece of metanotum well developed (fig. 142).

Fore wings hyaline, rather finely and densely ciliated; the basal posterior hairless streak bent upward at its distal end. Submarginal vein distinctly longer than the marginal; stigmal about as shown in Figure 88. Marginal fringe moderately short.

Mesoscutum moderately densely setose, setae along the sides and posterior margin slightly stronger than elsewhere. Scutellum with three pairs of strong bristles. Each parapsis with three setae and each axilla with two. The setae somewhat darker than the derm but not strongly contrasting.

Basitarsus of middle legs almost as long as the succeeding four joints united; tarsi moderately short and furnished with numerous peg-shaped spines; tibial spur slightly shorter than the basitarsus. Paired spurs at apex of hind tibiae very unequal.

Male.—The males differ from the females in coloration and antennal characters.

General color yellow with extensive blackish to dark brown markings as follows: Occiput on either side and above foramen; ocellar triangle; pronotum; large triangular blotch on anterior part of mesoscutum; posterior half of parapsidal grooves; a faint rounded spot on each parapsis; axillae; triangular blotch on base of scutellum; sides of metanotum; propodeum; and the whole abdomen. Tegulae and median piece of metanotum pale yellow. Face and cheeks, venter of thorax, legs and antennae pale yellow. Tarsi of fore legs entirely dusky, apical joint of middle tarsi and apical two joints of hind tarsi dusky. Sensoria on flagellum dusky.

Pedicel short, wider than long. Flagellum large with numerous sensoria; joints symmetrical and medially articulated. Club differentiated, rather small, narrower than funicle. First funicle joint the longest, about twice as long as wide; second and third successively shorter. Club about as long as the first and one-half of the second funicle joints combined. First club joint much smaller than the third funicle joint (fig. 150).

Length 0.84 mm.

Redescribed from eight females and five males (cotypes) on a single slide, U.S.N.M. No. 20668, also labeled "Queensland Museum." The original description gives the following data: "From many pairs reared from galls on *Leptosperum flavescens*, September, 1915 (H. Hacker). Types in the Queensland Museum, Brisbane, 9 females 4 males on slide. U. S. Nat. Mus., 1 male, 17 females on slide." Presumably the gall referred to as a host was actually a gall-like coccid.

23. COCCOPHAGUS INKERMANI Girault

Plate 8, Figure 36; Plate 11, Figure 101

Cocophagus inkermani GIRAULT, New Pests from Australia, III; Brisbane, Queensland, August 25, 1926. (Published by author.)

Girault's original description follows: "Follows *perhispidis*. Abdomen with rather wide stripes across middle (less than ½ surface). Orange, legs white, apex, abdomen black. Funicle 1 longest, twice longer than wide. Inkerman, Q."

Owing to the condition of the type it is difficult to add much of value to the original description. The type specimen is split longitudinally, the head is missing, the wings folded, and obscured. Cracks in the balsam and a piece of glass adhering to the specimen add to the difficulty of obtaining a clear view.

One antenna remains intact but it is folded and distorted. This antenna is shown in Figure 36. Of the other antenna, the club and distal two funicle joints remain. The remnants of the second antenna indicate that the apical funicle joint and club are more

elongate than that shown in the figure. It is likely that the club is more nearly like that of *C. perhispidis* Girault than the figure shows. No suture can be detected separating the apical two club joints and the suture between the first and second is hardly discernible. The pedicel appears slightly longer than wide. First funicle joint plainly the longest, almost twice as long as wide; second and third successively shorter and wider. It is suspected that the club as seen in the type is distorted almost beyond recognition. In Figure 36 the curvature of the scape is probably due to a dorsal view instead of the usual lateral view.

Fore wings with the disk finely and densely ciliated. Marginal fringe very short. Submarginal vein about as long as the marginal and furnished with about twelve setae. The shape of the stigmal and postmarginal veins can not be determined with accuracy. A hypothetical reconstruction based on the position of the setae, clear pustules and wing margin is shown in Figure 101.

Scutellum apparently almost as long as wide and furnished with three pairs of bristles.

So far as can be ascertained, the coloration is as described by Girault with the addition that the center of the pronotum and median anterior portion of the mesoscutum are black. Wings clear hyaline.

Basitarsus of middle legs almost as long as the succeeding joints united; tibial spur slightly shorter than the basitarsus; tarsi with numerous peg-shaped setae.

Measurements in mm.: Length of body (exclusive of head) 0.8. Marginal vein 0.26; submarginal 0.26; longest marginal fringe 0.0096. Five tarsal joints of middle legs united 0.3; basitarsus 0.12 long; tibial spur 0.104 long. Scape 0.12 long by 0.0264 wide. Pedicel 0.0344 long by 0.0296 wide. First funicle joint 0.0496 long by 0.0288 wide; second 0.03128 long by 0.0312 wide; third 0.034 long by 0.04 wide. Club 0.0680 long by 0.0520 wide.

Redescribed from female type, Queensland Museum. No locality or collection data on slide label.

24. COCCOPHAGUS BOGORIENSIS (Köningsberger)

Plate 8, Figure 37; Plate 11, Figure 98; Plate 12, Figure 141

Encyrtus bogoriensis KÖNINGSBERGER, Meded. Plant., vol. 20, 1897, pp. 14–15, pl. 1, fig. 9.

Coccophagus javae GIRAULT, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 482.

The specimens described by Girault as *Coccophagus javae* agree fairly well with the description of *C. bogoriensis* (Köningsberger). The fact that series of specimens were reared from the same host collected in the same locality tends to support the belief that the two forms are identical. In his description of *C. javae*, Girault said

that according to Van der Goot the species had been described by Köningsberger *as Encyrtus bogoriensis*, but that he had been unable to see the description of this species. Köningsberger wrote that the species is a common parasite of *Coccus viridis* (Green) in Java, where the coccid is a pest of coffee.

Coccophagus bogoriensis is related to *C. Lecanii* (Fitch) and its allies.

Female.—Scutellum mostly yellow, anterior margin dark. Thorax dark brown; abdomen darker than the thorax, blackish. In the balsam-mounted specimens, the ocellar triangle appears dark; eyes and ocelli red and the remainder of the frontovertex yellowish. Face and cheeks yellowish, becoming paler toward the mouth, in life, possible appearing white. Scape whitish, flagellum brownish yellow with darker sensoria. Legs mostly pale yellow or whitish, only the hind femora and tibiae with a variable amount of dusky.

The comparative lengths of the funicle joints vary slightly among the different specimens or else the apparent variations are due to the different positions of the antennae. Apparently the first funicle joint is slightly the longest and the succeeding joints each a trifle shorter and wider. The antenna that appeared to be best preserved was measured with the following results: first funicle joint a trifle more than one and one-half times as long as wide; third one and one-third times as long as wide; second intermediate between the first and third. None of the pedicels is clearly shown, but so far as can be judged it appears to be about one and one-third times as long as wide and much shorter than the first funicle joint (fig. 37).

Proportions of the body and arrangement of the setae not unlike those of *C. lecanii* (Fitch); however, a study of properly mounted specimens may reveal differentiating characters that are not apparent in the specimens at hand. A portion of the thorax is shown in Figure 141.

Fore wings hyaline, finely and closely ciliated; a small rounded, hairless spot near the base. Marginal vein slightly longer than the submarginal; stigmal shown in Figure 98.

Measurements in mm.: Length 1.10. Pedicel 0.044 long by 0.0344 wide. First funicle joint 0.0640 long by 0.04 wide; second 0.0560 long by 0.0416 wide; third 0.0568 long by 0.0424 wide. First club joint 0.0584 long by 0.0456 wide; second 0.0560 long by 0.0448 wide; third 0.0504 long by 0.0336 wide. Fore wings 0.78 long by 0.36 wide. Marginal vein 0.25 long; submarginal 0.22 long.

Redescribed from 10 females (cotypes of *C. javae* Girault) U.S.N.M. No. 19888. According to Girault's description, reared from *Lecanium viride* [*Coccus viridis* (Green)], Salataga, Java, January, 1915, P. Van der Goot, collector.

25. COCCOPHAGUS CUBAENSIS, new species

Plate 8, Figure 38; Plate 11, Figure 113

This species from Cuba is another form closely related to *C. lecanii* (Fitch). It is most easily distinguished from the related species by coloration; legs entirely pale yellow, venter and most of the sides of thorax yellow.

Female.—General color black, or blackish to dark brown in parts, with the antennae, scutellum, median piece of metanotum, venter of thorax, tegulae, prepectus, mesopleura, and metapleura lemon yellow. Anterior margin of scutellum sometimes narrowly blackish and sometimes with more or less blackish or brownish suffusing the yellowish coloration on the sides of the thorax. Legs entirely pale lemon yellow.

The antennal proportions are not unlike those of the other species of this group, namely, first funicle joint slightly the longest, the second and third succesively a trifle shorter and wider. In this species the sensoria are not so numerous as in *C. bogoriensis* (Köningsberger), *C. pulvinariae*, new species, and *C. tibialis*, new species. Antennae shown in Figure 38.

Stigmal vein as shown in Figure 113. In other details the fore wings are not essentially different from those of *C. lecanii.*

Length 0.95 mm.

Type.—Cat. No. 42094, U.S.N.M.

Described from 20 females (holotype and paratypes) reared by Dr. F. Silvestri from *Pulvinaria* (A) on citrus, Santiago de las Vegas, Cuba, October, 1928.

26. COCCOPHAGUS PULVINARIAE, new species

Plate 8, Figure 39; Plate 11, Figure 127

This is another species of the *C. lecanii* (Fitch) group that is distinguished by coloration.

Female.—General color black. Face, cheeks, and antennae orange yellow. Scutellum entirely pale lemon yellow, or at most the anterior margin very narrowly blackish. Middle and hind coxae more or less blackish basally, remainder of the legs usually entirely yellow.

Scape fusiform, slightly widest just beyond the middle, a trifle more than four times as long as wide. Pedicel about one and two-fifths times as long as wide and plainly shorter than the first funicle joint. First funicle joint the longest, one and three-fifths times as long as wide; second and third each successively a trifle shorter and wider so that the third is slightly less than one and one-fourth times as long as wide. First club joint as long as the pre-

ceding funicle joint and a trifle wider; second and third successively shorter and narrower; all longer than wide (fig. 39).

Mandibles with the ventral and median tooth subequal and with a broadly rounded dorsal tooth.

Fore wings subhyaline, faintly and uniformly smoky, cilia fine and dense. Marginal vein slightly longer than the submarginal. Stigmal vein as shown in Figure 127. Marginal fringe short.

Basitarsus of middle legs as long as the four succeeding joints united; tibial spur plainly shorter than the basitarsus. Paired spurs of hind tibiae subequal.

Ovipositor as seen through the derm arises near the middle of abdomen.

Sculpture and vestiture similar to *C. lecanii* (Fitch).

Measurements in mm.: Length 0.90. Scape 0.456 long by 0.0352 wide. Pedicel 0.0520 long by 0.376 wide. First funicle joint 0.0760 long by 0.0480 wide; second 0.0672 long by 0.0488 wide; third 0.0648 long by 0.0512 wide. First club joint 0.0648 long by 0.0544 wide; second 0.0544 long by 0.0488 wide; third 0.0464 long by 0.344 wide. Fore wings 0.84 long by 0.38 wide. Marginal vein 0.26 long; submarginal 0.24 long. Longest marginal fringe 0.016.

Male.—Face, cheeks, and antennae pale lemon to orange yellow; frontovertex with a variable amount of fuscous. Parapsides, especially the expanded parts, often suffused with orange. Legs yellow; middle and hind coxae black, apical joint of the middle and hind tarsi fuscous, and the fore tarsi faintly brownish.

Type.—Cat. No. 28971, U.S.N.M.

Described from 35 females and 10 males (holotype, allotype, and paratypes) reared by E. W. Rust as follows: 17 females, 1 male reared from *Pulvinaria mercei* on fern (and other hosts?) Durban, Natal, October, September, 1925, and February, 1927, Rust's No. C–12; 2 females and 1 male reared from *Coccus hesperidum* Linnaeus, Durban, Natal, September, 1925, and May, 1927; 15 females and 1 male reared from *Pulvinaria jacksoni* June, 1926, and May, 1927, Rust's No. C–34; 3 males reared from *Inglisia* species, Mayville, Natal, May, 1926, Rust's No. C–12.

27. COCCOPHAGUS JAPONICUS Compere

Plate 8, Figure 40

Coccophagus japonicus COMPERE, Bull. So. Calif. Acad. Sci., vol. 23, pt 4, 1924, pp. 122–23.—GAHAN, Proc. Ent. Soc. Wash., vol. 28, No. 1, 1926, p. 24.

This is a Japanese species belonging to the *C. lecanii* (Fitch) group.

Female.—General color black, posterior two-thirds of the scutellum yellow. Head black. Scape blackish; flagellum brown with

darker sensoria. Some specimens with all legs pallid white or yellow except for more or less blackish on the hind femora and the basal part of fore coxae black. Others have the fore and middle coxae black and hind femora black except the ends which are yellow. Again some specimens agree with the foregoing except that the fore femora and tibiae are more or less suffused with blackish. Femora of middle legs of all specimens entirely yellow. Tibiae and tarsi of all legs yellow or pallid white except the apical tarsi, which are fuscous, and the fore tibiae which are occasionally brownish or suffused with blackish.

Antennae as shown in Figure 40.

Redescribed from paratypes received June 2, 1923, from C. P. Clausen, who collected the material in the vicinity of Yokohoma, Japan. Parasitic on *Coccus pseudomagnoliarum* (Kuwana).

28. COCCOPHAGUS HAWAIIENSIS Timberlake

Plate 8, Figure 41; Plate 14, Figure 185

Coccophagus hawaiiensis TIMBERLAKE, Proc. Haw. Ent. Soc., vol. 6, No. 2, 1926, pp. 315–17, fig. 3.

This form has been adequately described by Timberlake. Typical specimens are rather easily distinguished from *C. japonicus* Compere by the different coloration of the legs. There are, however, certain specimens in the collection of the United States National Museum showing intergradations and in one series of specimens, all of which were supposedly reared from the same host, there are individuals that agree with types of both *C. japonicus* and *C. hawaiiensis*. Typical specimens of *C. hawaiiensis* are most readily distinguished from *C. japonicus* by the coloration of the middle legs, *C. hawaiiensis* having the middle femora more or less black or brown.

Antennae as shown in Figure 41. Mandibles as shown in Figure 185.

The species studied by T. I. Ishii under the name *C. lecanii* (Fitch) is referred to this form.[25] Gahan has shown that the records of *C. lecanii* from Japan were based on an incorrect determination.[26] His notes on the coloration of *C. japonicus* are in better agreement with typical *hawaiiensis* than they are with typical *C. japonicus*. However, it is not unlikely that the two forms are specifically alike as supposed by Gahan. If there is a specific distinction, the species studied by Ishii is to be referred to *C. hawaiiensis* rather than to *C. japonicus*.

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[25] Ishii, Jap. Bull. Imp. Plant Quar. Sta., No. 3, 1923, pp. 66–95, pl. 17, figs. 1–8.
[26] Gahan, Proc. Ent. Soc. Wash., vol. 28, No. 1, 1926, p. 24.

29. COCCOPHAGUS TIBIALIS, new species

Plate 8, Figure 42

This is a Philippine Island species of the *C. lecanii* (Fitch) group. It can be most conveniently distinguished by the hind tibiae, which are entirely black or dark brown.

Female.—General color black; scutellum and median piece of metanotum bright lemon yellow except that the anterior margin of the former may be very narrowly black. Face and scape brownish, flagellum piceous due to the dark sensoria. Coxae, trochanters, and femora of all legs black or dark brown except that the femora of the fore and middle legs are paler at the apices and the middle pair have a faint annulus at base. Fore tibiae mostly brown, pale at apices. Middle tibiae dark brown or black on basal two-thirds or so and yellow or sordid white on the remainder. Hind tibiae entirely dark brown or black. All tarsi yellow or sordid white.

Scape slightly fusiform about three and three-fourth times as long as wide. Pedicel about one and one-third times as long as wide and much shorter than the first funicle joint. First funicle joint the longest, about one and two-thirds times as long as wide; second and third each successively a trifle shorter and wider, the third about one and one-fourth times as long as wide. First club joint subequal in length and a trifle wider than the third funicle joint; second and third successively shorter (fig. 42).

Mandibles with the ventral and median teeth subequal, the dorsal broadly rounded.

Fore wings hyaline; cilia fine and dense; the posterior basal hairless streak bent upward at its distal end. Marginal vein slightly longer than the submarginal. Length of longest marginal fringe 0.0352 mm.

Basitarsus of middle legs a trifle shorter than the succeeding joints united: tibial spur plainly shorter than the basitarsus. Paired spurs at apex of hind tibiae unequal.

Ovipositor as seen through the derm arises near the middle of abdomen.

Sculpture and vestiture similar to *C. lecanii* (Fitch).

Length 0.9 mm.

Male.—Body entirely black. Face in proximity to mouth and the scape and pedicel brownish; flagellum dark due to blackish sensoria. Except for the tarsi, all legs entirely dark brown to blackish. Tarsi brownish yellow except the apical joints, which are fuscous.

Type.—Cat. No. 42092, U.S.N.M.

Described from 18 females and 2 males (holotype, allotype, and paratypes) reared by Harold Woodworth from *Saissetia oleae* (Bernard), *Saissetia hemisphaerica* (Targioni), and *Coccus viridis* (Green), Los Banos, Philippine Islands, 1921.

30. COCCOPHAGUS COWPERI Girault

Plate 3, Figure 3

Coccophagus flavoscutellum Masi (not Ashmead) Boll. Lab. Zool. Gen. Agr. Portici, vol. 1, 1907, p. 239, fig. 4.

Coccophagus cowperi Girault, Descriptiones Stellarum Novarum, 1917, p. 1.

Coccophagus lecanii Gahan, Proc. U. S. Nat. Mus., vol. 71, Art. 4, 1927, pp. 24–25.—Smith and Compere, Univ. Calif. Pub. Ent., vol. 4, No. 9, 1928, pp. 247–254.

In a recent paper on the Parasites of *Saissetia oleae* (Bernard),[27] the writer treated this form under the name *C. lecanii* (Fitch) and in a footnote stated that there was doubt concerning its identity and that the figure and life history notes were based on a study of specimens received from Cape Town, South Africa. Gahan,[28] makes *C. cowperi* Girault a synonym of *C. lecanii* (Fitch) and expresses the belief that the African specimens represent merely a variation or at most a geographical race of *C. lecanii*. He also says that the types of *C. cowperi* were reared from *Stictococcus gowdeyi* Newstead, collected at Nagunga, Uganda, Africa. Since it is necessary to recognize the existence of this form, race, variety, or species, as the case may be, it is for uniformity treated as a species so as to be in agreement with the rank tentatively given to *C. elaephilus*, Silvestri, *C. pulvinariae*, new species. *C. isipingoensis*, new species, *C. tibialis*, new species and *C. cubaensis*, new species.

A series of specimens collected in Italy and loaned for study by Doctor Silvestri were determined as *C. flavoscutellum* Ashmead by Masi and were mentioned by him under this name. So far as I can determine, all the specimens studied by Masi are in exact agreement with the South African form treated as *C. cowperi* Girault in this paper.

Figure 3, illustrating the adult of *C. cowperi* Girault, is a typical, medium sized species and it is set as the standard when statements of comparison are made. The slight differences that serve to distinguish this form from *C. lecanii* are given in the keys.

31. COCCOPHAGUS ISIPINGOENSIS, new species

Plate 5, Figure 7; Plate 8, Figure 43; Plate 11, Figure 130; Plate 13, Figure 163

The females of this species resemble those of *C. lecanii* (Fitch) closely enough to cause confusion but in the male sex the coloration of the legs is strikingly unlike.

Female.—Frontovertex orange yellow; coloration of face variable ranging from slightly dusky to black; antennae yellow; occiput blackish. Scutellum mostly yellow only the anterior margin more

[27] Smith and Compere, Univ. Calif. Pub. Ent., vol. 4, No. 9, 1928, p. 247.

[28] Gahan, Proc. U. S. Nat. Mus., vol. 71, Art. 4, 1927, p. 24.

or less black; median piece of metanotum yellow; occasionally the expanded part of the parapsides suffused with ferrugineous; mesosternum and ventral part of the prepectus and mesoepisterna shading to ferrugino-testaceous; remainder of thorax black. Abdomen black. All coxae black; trochanters apt to be pale with more or less blackish suffusions; fore femora blackish on basal half; middle femora with an annulus at base and yellow on apical one-third; hind femora more extensively black only the apical one-fourth yellow. Fore tibiae yellow or slightly brownish; middle tibiae completely yellow; hind tibiae mostly black, apical one-third or so yellow. Fore tarsi slightly brownish; apical joint of all tarsi dusky.

Pedicel almost one and one-half times as long as wide, plainly shorter than the first funicle point. First funicle point the longest, a trifle more than one and one-half times as long as wide; second and third successively shorter and slightly wider so that the third joint is not much longer than wide. Club joints successively decreasing in size; first and second about as wide as long; third plainly longer than wide (fig. 43).

Fore wings hyaline. Marginal vein a trifle longer than the submarginal; stigmal as shown in Figure 130.

Basitarsus of middle legs as long as the four succeeding joints united; tibial spur slightly but plainly shorter than the basitarsus. Paired spurs at apex of hind tibiae slightly unequal. Setae near articulation of middle femur and tibia moderately strong, black, as shown in Figure 163.

As seen through the derm, the ovipositor arises near the center of abdomen.

Length 0.95 mm.

Male.—Face and cheeks lemon yellow; frontovertex usually more or less suffused with fuscous and the ocellar area blackish; dorsal portion of occiput blackish, the ventral yellow. Expanded part of the parapsides more or less ferruginous; remainder of thorax and abdomen black. Legs lemon yellow except that the basal part of the coxae are more or less fuscous, the hind tibiae are blackish on the basal two-thirds, and the apical tarsal joints are fuscous.

The antennae are somewhat thicker than in the female and the sensoria on the first funicle joint are differently arranged.

Type.—Cat. No. 42090, U.S.N.M.

Described from 49 females and 15 males (holotype, allotype, and paratypes), reared by E. W. Rust as follows: 32 females and 7 males from *Coccus hesperidum* Linnaeus on *Hibiscus*, Durban and Isipingo, Natal, S. Africa, September 1925; 8 females from *Saissetia nigra* (Nietner), *Barberton*, Transvaal, May 1926; 2 females from *Saissetia persimile* (Newstead), Durban, Natal; 7 females and 8

males from *Filippia carissae* Brain, Durban, Natal, September 1925 and July 1926.

32. COCCOPHAGUS LECANII (Fitch)

Plate 11, Figure 131

Platygaster lecanii FITCH, Fifth Rept. Insects, New York, 1858, pp. 25–26.
Coccophagus lecanii A. E. SMITH, Amer. Nat., Phil., vol. 12, 1878, p. 661, fig. 6, *a–b*.—SMITH, Seventh Rept. State Ent., Ill., 1878, p. 130.—PUTMAN, Proc. Davenport Acad. Nat. Sci., vol. 2, 1879, pp. 297, 332–33.—HOWARD, U. S. Dept. Agr. Rept. Ent. for 1880, 1881, p. 357.
Coccophagus ater HOWARD, Rept. Ent. U. S. Dept. Agr. for 1880, 1881, pp. 359–60.
Coccophagus cognatus HOWARD, Rept. Ent. U. S. Dept. Agr. for 1880, 1881, p. 359.
Coccaphagus flavoscutellum ASHMEAD, Florida Agr., vol. 4, 1881, p. 65.
Coccophagus vividus HOWARD, U. S. Dept. Agr. Div. Ent., Bull. 5, 1885, p. 25.
Coccophagus cognatus HOWARD, U. S. Dept. Agr. Div. Ent. Bull. 5, 1885, p. 25.—HUBBARD, Insects Affecting the Orange, U. S. Dept. Agr. Div. Ent., 1885.
Coccophagus californicus HOWARD, Insect Life, vol. 1, 1889, p. 269.
Coccophagus lecanii GAHAN, Proc. U. S. Nat. Mus., vol. 65, art. 4, 1924, p. 12; Proc. Ent. Soc. Wash., vol. 28, No. 1, 1926, p. 24; Proc. U. S. Nat. Mus., vol. 71, art 4, 1927, pp. 24–25.
? *Coccophagus cowperi* GIRAULT, Descriptiones Stellarum Novarum, 1917, p. 1.
Coccophagus coccidis GIRAULT Descriptiones Stellarum Novarum, 1917, p. 2.

Except for *C. californicus* Howard, the above synonomy is that given by Howard and Gahan. In the literature *C. lecanii* (Fitch) is indirectly synonymized with *C. scutellaris* (Dalman) through *C. flavoscutellum* Masi (not Ashmead). The chain of synonomy linking *lecanii* (Fitch) and *scutellaris* (Dalman) is undoubtedly incorrect, for Dalman's original description applies to the species that has previously been known as *Coccophagus lunulatus* Howard.

In the past, *Coccophagus lecanii* (Fitch) has led to more confusion and synonomy than has any other species and unless more refined and exact methods of study are developed, it is likely to continue to be an enigma. The characters used in this paper to distinguish the females of certain so-called species are not essentially different from the characters used by Howard to separate his departures that have been synonymized. In this study, however, with one exception both sexes are represented in the series of specimens and even though the females are similar enough to cause confusion the males are strikingly different. In certain groups of insects it has been found that polymorphic males from different geographical localities are referrable to one species and if this proves to be the case in regard to *Coccophagus*, then the so-called species *C. cowperi* Girault, *C. pulvinariae*, new species, *C. isipingoensis*, new species, *C. cubaensis*, new species, and *C. eleaphilus* will probably be relegated to synonomy. It is possible that the forms of the *C. lecanii* group can not be accurately defined or understood on the basis of taxonomic studies and that it will be necessary to discover their genetic rela-

tionship before they can be assigned to their proper systematic position.

Coccophagus cowperi Girault is the common form in the vicinity of Cape Town. This form can not be satisfactorily separated from certain individuals found in North America which are referred to *C. lecanii* (Fitch). The specimens at hand seem to indicate that *C. cowperi* Girault is intermediate between *C. eleaphilus* Silvestri, *C. pulvinariae*, new species, *C. isipingoensis*, new species on the one side and C. lecanii (Fitch) of North America on the other side. *C. pulvinariae*, new species and *C. isipingoensis*, new species are represented in the collection of the Citrus Experiment Station by good series of specimens that do not show any intermediates, yet the two forms co-exist and are recorded from a common host, *Coccus hesperidum* Linnaeus.

KEY TO THE MALES OF CERTAIN SPECIES CLOSELY RELATED TO COCCOPHAGUS LECANII (FITCH)

1. Femora or tibiae of all or at least one pair of legs marked with blackish or brownish.....2.
   All femora and all tibiae yellow, only the middle and hind coxae black. **pulvinariae**, new species.
2. Femora of at least one pair of legs marked with blackish or brownish....3.
   All femora and fore and middle tibiae yellow. Middle and hind coxae black. Hind tibia mostly black, the apex yellow.....**isipingoensis**, new species.
3. Fore and middle femora yellow.....4.
   All femora mostly black, the ends tipped with yellow. All coxae black. Fore and middle tibiae yellow. Hind tibiae more or less extensively suffused with blackish at base.....**lecanii** (Fitch).
4. Hind tibia predominantly black, yellowish at apex.....5.
   Hind tibiae yellow, hind femora mostly black, yellow at apex. **cowperi** Girault.[29]
5. Hind tibiae as well as the hind femora mostly black or dark brown. All coxae black. Fore and middle femora and tibiae yellow. **eleaphilus** Silvestri.

The following description applies to what is considered a typical specimen of *C. lecanii* (Fitch) from North America.

Female.—Face, cheeks, and frontovertex predominantly blackish or brownish, the latter with a pattern of orange colored lines. Scape and pedicel fuscous, the flagellum yellowish. Apical two-thirds of scutellum and the median piece of the metanotum bright lemon yellow, the remainder of thorax and abdomen black. All coxae black. All trochanters yellow. All femora with a sharply defined narrow, yellow annulus at base and at apex tipped with yellow, the yellow more extensive at the apices of the fore and middle femora than on the hind femora; the intermediate parts blackish. Fore tibiae predominantly yellow, more or less suffused with fuscous near the base.

[29] The males of *C. japonicus* Compere run to *cowperi* in this key yet the two forms are undoubtedly distinct as the females offer good characters for their separation and the larvae are unlike.

Middle tibiae entirely yellow. Hind tibiae more or less extensively fuscous at base, the apical half or so yellow, the two colors gradually blending without a sharp line of demarcation. Apical tarsal joints fuscous, the other tarsal joints yellow.

Usually the flagellum has fewer sensoria than is commonly seen in the related African species. As seen from one side, on each joint of the funicle two sensoria are usually sharply defined in one focal plane; the first and second club joints usually show three sensoria, while the third joint shows one. In the African forms the sensoria are more numerous and closer together so that in one focal plane three and four sensoria can be clearly seen on the funicle joints. The antennal differences are not at all constant and can not be relied upon unless taken in combination with other characters.

As a rule the fore wings are less densely setose and the setae are finer than in the African forms. As with the antennal differences, the character of the wings is variable.

Male.—Face, cheeks, frontovertex, antennal scape, and pedicel fuscous. Flagellum yellow. All coxae black, all trochanters yellowish. All femora mostly black, the ends yellow. Fore and middle tibiae yellow. Hind tibiae suffused at base with more or less blackish, the remainder yellow. Apical tarsal joint fuscous, the other tarsal joints yellow. Entire thorax and abdomen black.

Coccophagus californicus Howard is undoubtedly another synonym of *C. lecanii* (Fitch). The type female is mounted in balsam on a slide and crushed. If the under side of the specimen is viewed in a subdued light or against a dark background the coloration appears exactly as described by Howard, namely " mesoscutellum lighter in color than the rest of the thorax, except at immediate base, its posterior edge with a narrow band of bright lemon yellow extending from one lateral angle around the curved border to the opposite lateral angle, of nearly equal width throughout, at its widest portion measuring 0.027 mm." This appearance of distinctive coloration is due to a difference of refraction caused by a deposit of body fluids that accumulated and dried around the apical curvature of the scutellum when the specimen was crushed. So far as can be seen, the type female does not otherwise differ from typical specimens of *C. lecanii* from California. Actually the apical two-thirds of the scutellum is yellow with the basal third blackish.

32a. COCCOPHAGUS FUSCIPES Howard

Coccophagus fuscipes Howard, U. S. Dept. Agr. Rept. Ent. for 1880, 1881, p. 359.
Coccophagus fraternus Howard, U. S. Dept. Agr. Rept. Ent. for 1880, 1881, p. 359; U. S. Dept. Agr. Div. Ent., Tech. Ser. No. 1, 1895, p. 34.

I have had the privilege of examining the female cotype of *C. fuscipes*, a paratype of *C. fraternus* and four additional specimens

determined by Gahan as *C. fraternus*. So far as can be determined, *C. fraternus* is not unlike *C. fuscipes* and not essentially different from *C. lecanii* (Fitch). In my opinion *C. fuscipes* will ultimately be synonymized with *C. lecanii* (Fitch), but the separate identity of *C. fuscipes* is retained owing to my uncertainty.

In his Revision of the Aphelininae,[30] Howard makes *C. fuscipes* a synonym of *C. fraternus* although the latter has priority by reason of page precedence.

The following description is based on a study of the specimens labeled *C. fraternus*. The notes on the female cotype of the specimen labeled *C. fuscipes* were accidentally lost.

Female.—The paratype of *C. fraternus* has the apical half of the scutellum yellow and the basal half black. Median piece of metanotum yellow, remainder of thorax and the abdomen black. (Fore legs and antennae missing.) Middle femora with a narrow pallid annulus at base, apex slightly brownish yellow. Hind femora entirely blackish. Middle tibiae dark brown on basal two-thirds, apical third yellowish; hind tibiae similarly colored. Tarsi yellowish with the apical joints dusky. Sides of thorax, face, and cheeks faintly suffused with brownish. Frontovertex faintly brownish, basal corners orange.

The specimens determined by Gahan as *C. fraternus* are blacker than the paratype. Scutellum with the basal part blackish. Median piece of metanotum yellow. Flagellum brownish yellow with blackish sensoria; scape and pedicel dark brown. Face and cheeks black. All coxae black. All femora mostly black, tipped at ends with yellowish. Fore tibiae mostly dark brown, pale at ends. Middle tibiae suffused with dark brown or blackish on basal half, remainder yellowish. Hind tibiae more extensively blackish than the middle tibiae, only the apical third yellowish. Tarsi yellow with the apical joints dusky.

Fore wings very faintly and uniformly infumated.

Male.—Similar to the female except for the scutellum which is entirely black and for the usual sexual differences.

Redescribed from one female, paratype, *C. fraternus* Howard, U.S.N.M. No. 2603, and from three females and one male determined as *C. fraternus* by Gahan and labeled: "Reared from *Lecanium nigrofasciatum*, College Park, Md., November 28, 1925. H. S. McConnell, collector."

[30] Howard, U. S. Dept. Agr., Tech. Ser. Bull. 1, 1895, p. 34.

33. COCCOPHAGUS ELEAPHILUS Silvestri

Coccophagus eleaphilus SILVESTRI, Boll. Lab. Zool. Gen. Agr., Portici, vol. 9, 1915, p. 318, fig. 69.—MASI, Novitate Zoologicae, vol. 24, 1917, pp. 122, 211–12.

I have had the opportunity of studying the cotypes of this form. It is closely related to *C. lecanii* (Fitch) and as in the case of *C. cowperi* Girault, and other species of the complex, an effort is made to maintain its separate identity until its genetical relationship is established. In his description, Silvestri compares this species with *C. flavoscutellum.* The form known to Silvestri as *C. flavoscutellum* is the same as the form treated as *C. cowperi* in this article.

Female.—All coxae and trochanters blackish. All femora more or less extensively blackish basally, the apices pale, straw colored. Fore and middle tibiae straw colored; hind tibiae mostly blackish, pale on apical one-fourth. Tarsi straw colored becoming dusky toward the apices. Head and body black except the scutellum which is more or less yellow apically.

Male.—Dorsum of head and the face marked with orange. Body black. All coxae blackish. Fore and middle femora and tibiae yellow; hind femora black, pale at ends. Hind tibiae black, pale on apical one-fourth.

The male of *C. cowperi* differs from this form by having the hind tibiae entirely yellow; sensoria fewer and those of the first funicle joint in two overlapping whorls.

Redescribed from one female and two males (cotypes) loaned by Doctor Silvestri. According to the original description reared from *Philippia* [*Filippia*] *chrysophyllae* Silvestri collected at Eritrea, Nefasit.

Masi records this form from the Seychelles Islands.

34. COCCOPHAGUS BIGUTTATUS Girault

Plate 10, Figure 78; Plate 12, Figure 139

Coccophagus biguttatus GIRAULT, Memoirs Queensland Museum, vol. 4, 1915, p. 51.

The body of the type female is in fairly good condition but the head is missing (fig. 139). This species can be recognized by the ovipositor which is exserted two-sevenths the length of the abdomen. Girault's description will enable recognition of the species. The sclerites of the thorax are very indistinct and the setae transparent. Apparently the scutellum is slightly wider than long but it is too indistinct to allow an accurate measurement. Scutellum furnished with three pairs of bristles.

Fore wings rather large, closely and finely ciliated (fig. 78). Submarginal vein slightly but plainly longer than the marginal. Stigmal vein of one wing obscured by a speck of dirt and that of the other wing too indistinct for study.

Basitarsus of middle legs about as long as the succeeding joints combined; tibial spur a trifle longer than the basitarsus.

Girault's description in part follows: "Pale honey yellow, the wings hyaline; pronotum at middle rather widely and a diamond shaped spot on each side of the thorax in vicinity of the axillae black. Stigmal vein very short, nearly sessile. Funicle joints not long, 3 quadrate, the other two a little longer than wide, subequal to the pedicel; the club well defined. Ovipositor valves dusky blackish. Abdomen distad with faintly indicated narrow cross stripes (just before apex). The two spots seem to be on the cephalic two-thirds of each axillae.

"From two specimens taken by sweeping *Lantana*, October 20, 1911.

"Habitat: Mackay, Queensland.

"Type: No. Hg/2933, Queensland Museum, Brisbane, one female on a slide."

The color pattern as described by Girault is now only faintly discernible. Center of pronotum and anterior margin of mesoscutum at center, blackish. Anterior two-thirds of axillae blackish with distinct reticulations.

Measurements in mm.: According to Girault the length of head and body is 0.72. Length of body, exclusive of head, and exserted ovipositor, 0.56. Length of exserted ovipositor sheaths 0.08. Length of thorax 0.28. Length of abdomen 0.28. Fore wings 0.56 long by 0.26 wide. Marginal fringe 0.028 long. Marginal vein 0.12 long; submarginal 0.18 long. Tarsi of middle legs 0.1456 long; basitarsus 0.056 long; tibial spur .0784 long.

Redescribed from type female. No data on slide other than name, female type, and Queensland Museum number.

35. COCCOPHAGUS ZEBRATUS Howard

Plate 8, Figure 44; Plate 11, Figure 91; Plate 14, Figure 178

Coccophagus zebratus HOWARD, U. S. Dept. Agr. Tech. Ser. No. 12, pt. 4, 1907, p. 81, Fig. 18.—MERCET, Trab. Mus. Cien. Nat. Madrid, No. 10, 1912, p. 246

This aberrant species is recognizable by the original description. Aside from distinctive coloration, it possesses unusual structural characters, notably, the swollen hind coxae and femora, and sharply tridentate mandibles. The original color pattern of the two type females is difficult to detect because of fading, the yellows and browns appearing somewhat alike.

Female.—Club dark brown, almost black; first two funicle joints lighter than the club; third funicle joint white in sharp contrast. Pedicel light brown basally, paler towards the apex. Dorsal margin of scape light brown, the remainder whitish, concolorous with face. According to Howard, frontovertex lemon yellow, as is the occiput,

pronotum, and mesonotum. Also, according to Howard, metascutum (metanotum and propodeum?) brown. Face and remainder of the thorax whitish. Abdomen whitish with a broad, transverse, brownish band on each segment. Exserted ovipositor sheaths brownish. All coxae and femora and fore tibiae whitish. Middle and hind tibiae slightly brownish at base. Basitarsus of middle and hind legs dark brown in contrast to the other tarsal joints.

Mandibles sharply tridentate as shown in Figure 178.

Scape a trifle wider than usual, slightly less than three and one-half times as long as wide. (The figure shows the scape to be a trifle longer.) Pedicel apparently just a trifle shorter than the first funicle joint, the difference not appreciable without actual measurement; about one and one-third times as long as wide. Second funicle joint a trifle the longest, by measurement, but to the eye it appears equal. All funicle joints of approximately the same width and all plainly longer than wide, slightly asymmetrical, ventrally articulated. Club well developed, somewhat wider than the funicle (fig. 44).

Scutellum strongly transverse, much shorter than the mesoscutum. Abdomen elongate, more than twice as long as wide. Ovipositor, as seen through the derm, arising far anterior to the center and exserted about one-eighth the length of abdomen.

Mesoscutum with relatively few, scattered, moderately long setae, there being two on the posterior margin, three along each side and about thirty-six scattered on the disk. Scutellum with three pairs of bristles, the anterior pair as long as those of the mesoscutum and placed directly behind the two setae on the posterior margin of the mesoscutum. The median pair of scutellar bristles is widely spaced and intermediate in size; apical pair the longest and also widely spaced. Each axilla with three setae instead of the usual two. Each parapsis with three setae. Seventh tergite with long dark setae. Fifth and sixth tergites with setae aligned across the dorsum; the second, third, and fourth tergites with a few weak pale setae on the sides.

Coxae and femora of hind legs noticeably swollen. Basitarsis of the middle legs about as long as the three succeeding joints combined; tibial spur slightly longer than the basitarsus. Hind tibiae at apex with one spur almost one-half as long as the basitarsus, paired with another one-half as long and somewhat stronger; in addition there are several peg-shaped spines at apex.

Fore wings hyaline, cilia moderately dense and coarse for a small species. A hairless streak extends along the posterior margin at base. Wings somewhat more narrow than usual, about three times

as long as wide. Marginal vein slightly longer than the submarginal; stigmal as shown in Figure 91.

Redescribed from two females (cotypes) U.S.N.M. No. 10308, reared from *Aclerda distorta* Green, collected by E. E. Green at Punduloya, Ceylon.

36. COCCOPHAGUS TRIFASCIATUS Compere

Plate 8, Figure 45; Plate 11, Figure 89.

Coccophagus trifasciatus COMPERE, Univ. Calif. Pub. Ent., vol. 3, No. 3, 1925, pp. 311–13, pl. 26, fig. 14 A–D.—SMITH and COMPERE, Univ. Calif. Pub. Ent., vol. 4, No. 3, 1926, p. 53.—MERCET, Eos, Rev. Esp. Ent., vol. 3, No. 4, 1927, p. 496.

This is one of the few species without a postmarginal vein. The antennae are distinctive. In addition to the three pairs of bristles on the scutellum there are from five to thirteen small setae scattered near the anterior pair. The striking coloration of this species will also aid in its recognition.

Female.—Head yellowish to brownish, dorsum suffused with a variable amount of fuscous. Tips of the mandibles brown. Antennae brownish yellow. Pronotum blackish, the sides sometimes marked with yellow. Anterior one-third of mesoscutum blackish, the remainder, as well as parapsides, tegulae, and prepectus yellow. Scutellum mostly black, occasionally on the sides towards apex with elongate yellow spots. Axillae, metanotum, propodeum, and metapleura black. Mesopleura range from blackish to yellow. Venter of thorax and abdomen mostly yellowish. First tergite yellow with a black spot on either basal angle; second blackish on about the posterior third; third and fourth entirely blackish; fifth tergite blackish medially and yellowish laterally; sixth and seventh mostly yellowish medially and blackish laterally. Legs mostly yellowish. Hind tibiae suffused with blackish on basal two-thirds. Coxae of hind legs blackish basally. Femora and tibiae of fore and middle legs slightly tinged with dusky. All tarsi more or less faintly dusky.

Pedicel one and one-third times as long as wide and slightly longer than the first funicle joint. Funicle joints successively decrease very slightly in length and increase in width. First funicle joint a trifle longer than wide; second and third joints each a trifle wider than long. First club joint slightly longer than any of the funicle joints; second and third each a trifle smaller than first (fig. 45).

Scutellum about as long as wide and as long as mesoscutum. Abdomen about as long as thorax, sides subparallel for a greater part of their length. First and second abdominal segments fused without a traceable suture, these two comprising about one-third the length

of abdomen. Abdomen broadly rounded at apex. Ovipositor short and not exserted.

Fore wings hyaline, densely and closely ciliated, with a very short marginal fringe. Submarginal vein one-fourth longer than marginal; postmarginal absent. Stigmal vein not enlarged at apex nor much constricted at base, as shown in Figure 89.

Basitarsus of middle legs about as long as the three succeeding joints united; tibial spur slightly shorter than basitarsus.

Scutellum with three pairs of bristles and from five to thirteen small setae scattered in proximity to anterior pair of bristles. Pronotum and mesoscutum with numerous small, black setae. Each parapsis with four setae and each axilla with two setae, these being about as large as those scattered on scutellum. Metanotum, on either side, with two small setae set in punctures on anterior margin. Propodeum with small setae scattered on sides. Sides of second, third, and fourth tergites with a few small, dark setae in transverse alignment; fifth and sixth with the rows of setae complete across dorsum; seventh tergite with a median semicircle of setae and a few scattered, stronger ones.

Blackened portions of mesoscutum, axillae, and scutellum with areolate reticulations. Metanotum on either side with four wavy striations. Propodeum with two strong, sublateral carinae a short distance mesad of spiracles.

Length 0.9 mm.

Male.—Aside from sexual differences, the males differ from the females mostly in coloration. Body black, except for tegulae, a large part of parapsides and a spot on pleura close to root of fore wings which are yellowish. Tegulae sometimes marked with a black dot. Face and legs, except a greater part of hind tibiae bright yellow. Eyes a trifle smaller than in female, so that antennae are inserted about midway between oral margin and basal orbital line. Abdomen shorter than thorax.

Redescription based on the original description and additional specimens reared from *Saissetia oleae* received from South Africa. According to Rust *C. trifasciatus* is the most effective black scale parasite occurring in South Africa. Attempts were made to establish this species in California, and it was at least temporarily established, as specimens were reared from scales collected in California.

37. COCCOPHAGUS LUTESCENS, new species

A small species, yellow to pale white. Tibial spur of middle legs a trifle longer than the basitarsus; basitarsus as long as the succeeding two joints united.

Female.—General color pale yellow on the dorsum, fading to white on the sides and venter of thorax and on the face and cheeks.

Pedicel plainly larger than the first funicle joint, almost one and one-half times as long as wide. First funicle joint the smallest, about one and one-fourth times as long as wide, broadly fused to the second funicle joint; second and third successively wider and longer and each with a well-developed neck; both plainly longer than wide. Club large, as long as the funicle and at its widest point almost one and one-half times as wide as the third funicle joint. Second club joint with the dorsal margin much longer than the ventral. Pedicel and funicle furnished with sparse, large, pale setae.

Setae of the thorax hardly visible in the balsam-mounted specimens available for study. Mesoscutum with sparse, large, pale setae. Scutellum with three pairs of pale bristles.

Fore wings hyaline furnished with sparse, rather coarse setae. Marginal fringe 0.0492 mm. long. Submarginal vein slightly longer than the marginal; stigmal vein large, swollen at apex; postmarginal hardly developed.

Ovipositor, as seen through the derm, arises near the middle of abdomen.

Length 0.58 mm.

Male.—Face and cheeks white, frontovertex yellowish. Center of pronotum and anterior margin of mesoscutum in middle faintly dusky. Each axilla with a fuscous spot or suffusion anteriorly. Propodeum medially and dorsum of the abdomen, especially toward the apex, suffused with brownish or fuscous. Flagellum yellowish, scape white.

Club not differentiated from funicle; flagellar joints successively decreasing in size, ventrally articulated; sensoria numerous and as long as the segments.

Length 0.52 mm.

Type.—Cat. No. 42086, U.S.N.M.

Described from two females and one male (holotype, allotype, and paratype) on one slide mounted in balsam, reared by E. W. Rust from *Pulvinaria jacksoni*, Durban, Natal, September 9, 1925.

38. COCCOPHAGUS PERFLAVUS Girault

Plate 8, Figure 46; Plate 11, Figure 132; Plate 12, Figure 143

Coccophagus perflavus Girault, Societas Entomologica, vol. 31, 1916, p. 31.

A pale yellow species without any dark markings. *C. lutescens*, new species is closely allied to this form. *C. lutescens* has the face, cheeks, and venter of the thorax white, different antennal proportions, and longer basitarsus.

Female.—Head, body, legs, and antennae pale yellow. Ocelli and eyes red.

The exact proportions of the scape, pedicel, and first funicle joint are not easily seen and there may be a slight error due to the fact that these joints are partially obscured and shriveled. Scape subcylindrically fusiform, somewhat more than four times as long as wide. Pedicel more than one and one-half times as long as wide and about equal in length to first funicle point. First funicle joint shortest, slightly more than twice as long as wide; second and third successively longer and wider and each about twice as long as wide. Club strongly developed, its basal joint slightly shorter than third funicle joint and plainly wider, about one and one-half times as wide; second as long as first; third a trifle longer than preceding (fig. 46).

Mandibles partially obscured but apparently not greatly unlike those of *C. ochraceus* Howard.

Scutellum transverse, plainly much wider than long and plainly shorter than mesoscutum. Median piece of metanotum large, transverse (fig. 143). Abdomen crushed, showing ovipositor sheaths shortly exserted.

The vestiture of the mesonotum appears about as shown in Figure 143. On the anterior portion of the mesoscutum, the setae are obscured, as are the setae of the parapsides, and only one seta remains on the axillae. It is likely that the vestiture is similar to that of the male, which is revealed more distinctly and is described in more detail.

Fore wings hyaline, veins light, disk densely clothed with moderately coarse cilia. Marginal fringe moderately long, 0.0344 mm. Wings somewhat more than twice as long as wide. Submarginal vein slightly longer than marginal vein. Postmarginal shortly produced. Stigmal vein as shown in Figure 132.

Tibial spur of middle legs as long as basitarsus; basitarsus as long as three succeeding joints united.

Length approximately 0.8 mm. The specimens will not allow an accurate measurement.

Male.—Unlike the female in coloration and in antennal characters. Male antennae of the same structure as *C. ochraceus* Howard.

General color slightly brownish yellow or perhaps ochraceus, with fuscous or dark-brown markings as follows: Meson of pronotum, anterior margin of mesoscutum of the meson, propodeum between spiracles, basal angles of abdomen, and about the posterior half of the abdomen except the apex. A portion of each axilla faintly dusky.

Funicle and club not differentiated. Joints of flagellum ventrally articulated, dorsal margins at apex cut away, furnished with numerous sensoria which extend entire length of each segment. Pedicel short, apparently wider than long. Flagellar joints subequal in

length; first four roughly twice as long as wide, apical two joints more slender.

Mesoscutum with a reduced number of setae posteriorly, only a single strong pair near the posterior margin and anterior to these another pair not quite so strong. Most species have about five stronger setae in alignment along the parapsidal sutures, but this species has only one seta anteriorly on either side. The anterior two-thirds of the mesoscutum with moderately strong, sparse setae. Each parapsis with three setae. Each axilla with two setae.

Length about 0.68 mm.

Redescribed from two females and one male (cotype) U.S.N.M. No. 20002, labeled, "Bred from *Lecanium corni*, Madison, Wis., June 22, 1915, F. A. Fenton." One female is obscured under the excess of balsam squeezed out under the cover glass, the other is crushed. The male specimen is in the best condition but the antennae are partly concealed.

39. COCCOPHAGUS ARGENTEUS Girault

Plate 8, Figure 47; Plate 10, Figure 76; Plate 11, Figure 106, Plate 12, Figure 136

Coccophagus argenteus, GIRAULT, Memoirs Queensland Museum, vol. 4, 1915, p. 52.

The type female has been crushed beneath the cover glass but the important structural characters are to be seen as shown in Figure 136. The species can be recognized by the unusual wings as shown in Figure 76, and by the transverse scutellum. The wings of this species are unlike those of any other described species of *Coccophagus*.

Scape obscured beneath head but apparently about as shown in Figure 47. Pedicel slightly longer than wide and about as long as first funicle joint. Funicle joints ventrally articulated, all slightly longer than wide and about of same size and shape. Club as long as funicle joints combined and about one and one-half times as wide as distal funicle joint.

The character of the fore wing is best shown by the illustration, Figure 76. The wing from which the drawing was made is twisted at the base. The center of the wing is occupied by a slightly infuscated area, which is clothed with blackish cilia. The shape of this area is shown in the figure. Distad of the infuscated area the cilia are very fine and transparent. Marginal fringe long. Marginal vein as long as submarginal vein; stigmal and postmarginal as shown in Figure 106.

Thorax about as shown in Figure 136. The setae are rather coarse and blackish so as to be easily seen. Mesoscutum with about 40 setae, of about the same size as those on the axillae and the

anterior pair on the scutellum. Left axilla with only two setae present. Right axilla with four setae present. Apparently the left axilla never possessed more than two setae, for only two setiferous punctures are discernible. Scutellum with three pairs of setae or bristles.

Basitarsus of middle legs short, about one-third as long as five tarsal joints combined, or about as long as two succeeding tarsal joints combined; tibial spur slightly longer than basitarsus.

Girault's description gives many characters which are no longer discernible:

"Silvery white; the following parts honey yellow: Center of vertex, scutum, parapsides, and scutellum. The following parts jet black: Dorsum of abdomen excepting for three round spots in a triangle, one at apex, the other two opposite, at the lateral margin of the distal two-thirds; center of occiput; and the club except the distal half or more of distal joint. Lateral halves of each funicle joint and the axillae dusky.

"From one female taken on a window, January 16, 1914.

"Habitat: Gordon Vale (Cairns), Queensland.

"Type: No. Hg/2936, Queensland Museum, Brisbane, the female on a slide."

Measurements in mm.: Girault gives the length as 0.65. Pedicel 0.0312 long by 0.0224 wide. First funicle joint 0.0304 long by 0.0216 wide; second funicle joint 0.0360 long by 0.0240 wide; third funicle joint 0.0312 long by 0.0264 wide. First club joint 0.0376 long by 0.0384 wide; second club joint 0.0360 long by 0.0376 wide; third club joint 0.0360 long by 0.0368 wide. Fore wings, 0.48 long by 0.18 wide. Marginal vein 0.16 long; submarginal 0.16 long. Middle tarsi 0.1296 long; basitarsus 0.04 long; tibial spur 0.0496 long.

Redescribed from the type female in the Queensland Museum. No data on slide other than name, type designation, and museum number.

40. COCCOPHAGUS ARGENTIFASCIA Girault

Plate 8, Figure 48; Plate 10, Figure 83; Plate 11, Figure 93; Plate 12, Figure 137

Coccophagus argentifascia GIRAULT, Memoirs Queensland Museum, vol. 4, p. 54, 1915.

Girault, in his original description, describes the coloration of this species in detail and his description will probably enable identification of the species on the basis of coloration. The color pattern described by Girault is now only vaguely discernible. The species can be easily recognized by good structural characters, however, especially by the narrow fore wings. It belongs to the group of *Coccophagus* species which have the transverse scutellum. The fe-

male type is crushed on a slide but many of the important characters are shown in Figure 137.

Scape concealed beneath crushed head. Pedicel plainly longer than wide and a trifle shorter than first funicle joint. First funicle almost imperceptibly shorter than the third; second funicle joint plainly the longest; all of about same width and ventrally articulated so that the shape is not symmetrical, the ventral margin being the longest. Club large, about as long as first two joints and half of third funicle joint combined, and about one and one-half times as wide as third funicle joint (fig. 48).

Scutellum wider than long and furnished with three pairs of bristles. Each axilla with two setae. Each parapsis with three setae. Mesoscutum crushed, but on one-half there are about twenty-five setae and on the posterior margin there are two longer setae comparable in size with those of scutellum. On either side of tergites one, two, and three are two paired setae which are rather large for a delicate species; on either side of the fourth are five setae in transverse alignment.

Fore wings small, slender, clothed with rather coarse cilia. Marginal vein slightly longer than submarginal. Wing shown in Figure 83. Stigmal and postmarginal veins shown in Figure 93. The light brownish stripe mentioned by Girault no longer visible.

In life, the ovipositor may be shortly exserted. It is distinctly shortly exserted in the type specimen but this may be due to crushing.

Girault's description of the coloration is as follows: "Orange yellow; lower face, pronotum, propodeum, and immediate base of abdomen dusky. Abdomen black with a broad silvery white band across just out from base (occupying a little over a third of the surface). Legs except proximal half of coxae, silvery white. Antennae lemon yellow, distal club joint dusky. Fore wings with a light brownish stripe across them beginning a little distad of proximal third of marginal vein and ending a little distance distad of venation."

Measurements in mm.: Girault gives the length of female as 0.70. Fore wing, length 0.562; width 0.19. Length of marginal vein 0.18; length of submarginal 0.15. Longest marginal fringe 0.0224. Middle legs, length of five tarsi combined 0.16; length of basitarsus 0.0656; length of tibial spur 0.0582. Pedicel 0.04 long by 0.028 wide. First funicle joint 0.0448 long by 0.0216 wide; second funicle joint 0.0616 long by 0.0256 wide; third funicle joint 0.0520 long by 0.0240 wide; first club joint 0.0432 long by 0.0360 wide; second club joint 0.0428 long by 0.0360 wide; third club joint 0.0464 long by 0.0304 wide.

Redescribed from the type female, Queensland Museum No. Hg/2942. Girault gives the following data in his description:

"From one female taken from a window, February 24, 1914. Habitat: Gordon Vale (Cairns), Queensland."

41. COCCOPHAGUS BIVITTATUS, new species

Plate 8, Figure 49; Plate 10, Figure 84; Plate 11, Figure 105; Plate 13, Figures 147 and 153.

This form is closely related to *C. longifasciatus* Howard from which it is separated by the shorter ovipositor, small infuscated cloud beneath the stigma, and a slight difference in coloration. In this species the ovipositor arises near the middle, or approximately under the posterior margin of the fourth tergite, while in *C. longifasciatus* Howard, the ovipositor arises nearer the base, or approximately under the middle of the second tergite.

Female.—General color, lemon yellow with a longitudinal blackish band on either side of the body from pronotum to sixth tergite; sixth tergite yellow; seventh tergite blackish. A blackish blotch on either side of foramen. Upper portion of face and beneath the eyes iridescent pearly white. Eyes red. Antennal club and fore tarsi faintly fuscous. (Color description made from a freshly killed specimen.)

Pedicel plainly longer than the first funicle joint. Funicle joints asymmetrical, ventrally articulated. First funicle joint plainly the shortest, a trifle longer than wide; second and third subequal. Club large, broadly rounded at apex, as long as the funicle joints united, and about one and one-half times as wide as the third funicle joint (fig. 49).

Mandibles with a well-developed ventral tooth separated by a deep emargination from the dorsal truncation.

Fore wings with a small fuscous spot beneath the stigma and a trace of an infuscation beneath the upward bend of the submarginal vein. Marginal vein plainly longer than the submarginal; postmarginal very shortly produced; stigmal vein large and of distinctive shape as in Figure 105. Marginal fringe moderately long as shown in Figure 84.

Basitarsus of middle legs short, about as long as the succeeding two tarsal joints united; tibial spur plainly longer than the basitarsus.

Ocelli in an equilateral triangle, posterior pair remote from eye and occipital margin. Scutellum much wider than long and not so long as the mesoscutum. Median piece of the metanotum well developed, in tag mounts, appearing as a separate, triangular sclerite coalesced with the scutellum. Outline of body and vestiture as shown in Figure 147.

Length about 0.9 mm.

Male.—Mesoscutum, scutellum, median piece of metanotum, sides and venter of thorax and apex of abdomen lemon yellow. In colora-

tion head like that of female. The following parts blackish or dark brown: Pronotum, a blotch on the expanded part of the parapsides, most of axillae, sides of metanotum, propodeum, and most of abdomen.

Infuscated spot beneath the stigma obsolete or nearly so.

Antennae as shown in Figure 153.

Type.—Cat. No. 42100, U.S.N.M.

Described from 20 females and 1 male (holotype, allotype, and paratypes). Females reared by E. W. Rust from *Filippia carissae* Brain, collected at Durban, Natal, South Africa, October, 1925; and from *Inglisia elytropappi* Brain, Signal Hill, Cape Town, South Africa, December, 1924. Allotype male from *Saissetia oleae* (Bernard) Durban, Natal, Oct. 26, 1925.

42. COCCOPHAGUS LONGIFASCIATUS Howard

Plate 8, Figure 50; Plate 10, Figure 82; Plate 11, Figure 110

Coccophagus longifasciatus HOWARD, U. S. Dept. Agr. Bur. Ent. Tech. Ser. No. 12, pt. 4, 1907, pp. 80–81, fig. 17.—GIRAULT, Psyche, vol. 16, No. 4, 1909.—MERCET, Trab. Mus. Cien. Nat., Madrid, 1912, pp. 238–39.—SMITH and COMPERE, Univ. Calif. Pub. Ent., vol. 4, No. 9, 1928, p. 254.

Two female specimens from Foochow, China, collected by F. Silvestri, were determined by us as *C. longifasciatus* Howard on the basis of the original description. Rust reported the species from South Africa and sent specimens for study. The South African form is described as new in this paper under the name *C. bivittatus*. The principal differences between these two forms are given in the key and mentioned under *C. bivittatus*, new species.

C. longifasciatus was originally described from specimens reared by E. E. Green from *Saissetia nigra* (Nietner) collected at Manaar, Ceylon. The Chinese specimens in our collection are supposed to be identical with the Ceylon specimens but the determination is not positive.

43. COCCOPHAGUS CINGULIVENTRIS Girault

Plate 11, Figure 87

Coccophagus cinguliventris GIRAULT, Psyche, vol. 16, no. 4, 1909, pp. 79–80.—MERCET, Trab. Mus. Cien. Nat., No. 10, 1912, pp. 225–26.

Coccophagus cinguliventris is very distinct, not being closely related to any other described species. The comparatively long stigmal vein is strikingly different from that of any other described species. The habitus of this species is vaguely suggestive of *Aphelinus*. The sutures of the mesoscutum, axillae, parapsides, and scutellum are well impressed and the setae of the mesoscutum are less numerous than usual. This species has a distinctive coloration. The antennae also offer good characters for its recognition.

Female.—Mostly black, except for basal one-third of the abdomen, which is yellow in sharp contrast. Parapsides faintly brownish. Dorsum of head mostly orange yellow, ocellar triangle blackish. Eyes bright red. Face and antennae yellow. Cheeks blackish, the genal suture being the line of demarcation between the yellow of the face and the blackish of the cheeks. Legs pallid white, faintly suffused with yellowish in parts, especially on tarsi.

One antenna of the specimen studied was lost in an attempt to transfer it to balsam, the other antenna stuck to the glue on the tag. The following description of the antenna was made without measurements. Pedicel rather large, plainly larger than first funicle joint. First funicle joint plainly the smallest, about two-thirds as long as second funicle joint, and not much longer than wide. Second and third funicle joints subequal in length and a trifle wider than first. Sensoria not in marked contrast and hardly discernible in the tag mount. Setae of antenna pale and fine.

Forewings very faintly and indistinctly infuscated beneath stigma, cilia slightly coarse and moderately thick. Marginal fringe slightly longer than normal, 0.04 mm. Wings slightly longer than usual, about two and one-half times as long as wide. Marginal vein slightly longer than submarginal vein. Postmarginal vein absent. Stigmal vein long as shown in Figure 87.

Scutellum wider than long (9:6), rather broadly rounded at apex, not so long as mesoscutum (6:8). Parapsidal sutures well impressed. Axillae and scutellum not closely fused, the sutures distinct. Median piece of the metanotum large and prominent. Propodeum strongly elevated on the meson but this median ridge may be the result of shrinkage. Abdomen about one and one-half times as long as wide and about as long as thorax. Ovipositor not exserted.

Mesoscutum with a reduced number of setae, more closely arranged along the posterior and lateral margins. Each axilla with two setae similar to those of mesoscutum. Scutellum with three pairs of bristles, anterior pair closest together and no longer than those of mesoscutum, median pair also small but more widely spaced, apical pair longest but not as long as usual.

Mesoscutum, axillae, and scutellum strongly but finely areolate reticulated, the raised lines rather coarse and close, forming small aeroles, giving the scaly appearance described by Girault.

Length 0.9 mm.

The male is easily associated with the female by means of the several unusual characters mentioned in the description of the female.

Male.—Mostly blackish to brownish. Parapsides brownish yellow marked with blackish. Abdomen entirely black. Dorsum of

head orange, ocellar triangle blackish. Face mostly orange above merging to yellow below, including all the portion between genal sutures. Laterad of genal sutures, cheeks black. Blackish of cheeks continuous in a line arching above oral margin. Eyes red. Antennae slightly brownish yellow. Lateral and under parts of thorax more or less brownish. Legs pallid white to yellowish.

Antennae unlike those of female, club not differentiated and flagellum furnished with numerous sensoria. Pedicel short, apparently wider than long. Funicle and club joints apparently subequal in length.

Length 0.77 mm.

Redescribed from one female and one male in the United States National Museum, determined by A. B. Gahan; reared from *Lecanium nigrofasciatum*, Kent County, Maryland, June 1, 1911, A. B. Gahan, Coll.

44. COCCOPHAGUS MARGARITATUS, new species

Plate 5, Figure 10; Plate 8, Figure 51; Plate 10, Figure 77; Plate 11, Figure 108; Plate 13, Figure 154; Plate 14, Figure 184

This species is slightly suggestive of *Prospaltella* in certain respects. The fringe of the forewings is longer than usual in *Coccophagus* and the cilia of the disk are rather sparse and large. It is a distinctive species readily recognized.

Female.—Most of the head lustrous, pearly white, the face and frontovertex with some yellowish; occiput blackish. Antennae mostly yellow; scape whitish, yellow at apex. Eyes and ocelli scarlet. The following parts black to dark brown: Mesoscutum, axillae, median part of metanotum, propodeum, petiole, posterior margin of second tergite, third, fourth, and fifth tergites, proepisterna, mesopleura, prepectus, mesosternum, middle and hind coxae, venter of abdomen on apical half, and ovipositor sheaths. Parapsides and scutellum more or less ferruginous. Tegulae more or less yellow. Basal one-third or so of abdomen pale yellow to white. Sixth tergite yellow with a dark blotch on either side of the center. Seventh tergite yellow with dark median blotch. Cercal plates margined with dark brown posteriorly. Legs mostly white, in parts faintly yellowish, the middle and hind coxae black.

Scape slender, a trifle more than five times as long as wide. Pedicel, large, about one and one-half times as long as wide and plainly longer than the first funicle joint. First funicle joint the smallest, slightly longer than wide and slightly more than one-half as long as the second. Second and third funicle joints subequal, each somewhat more than one and one-half times as long as wide. Club large, as long as the funicle joints combined. First and second

club joints subequal, slightly wider than long, the third slightly longer and narrower than the preceding joint (fig. 51).

Manibles shown in Figure 184.

Fore wings hyaline, cilia on disk sparse and coarse; a row of cilia in straight alignment parallels the frenular fold. Marginal fringe long for *Coccophagus*, the longest cilia measuring 0.0288 mm. Marginal vein plainly longer than the submarginal; stigmal with a slender neck and widely expanded at apex; postmarginal indistinct and not produced so far forward as the stigmal. Entire fore wing as shown in Figure 77. Stigmal vein as shown in Figure 108. Scutellum plainly wider than long (5:3) and much shorter than the mesoscutum (6:11). Ovipositor suggestive of *Prospaltella*, the outer plates very wide. Ovipositor sheaths plainly exserted. The relative proportions of the abdomen as shown in Figure 10 are presumably a trifle broader than in life due to pressure of the cover glass on the balsam-mounted specimen from which the drawing was made.

In the balsam-mounted material, the setae on the frontovertex not discernible, setae on the face and cheeks fine and pale. Eyes densely, finely ciliated. Setae of the thorax and abdomen as shown (fig. 10). The arrangement of the setae on the abdomen is a good character for the identification of this species. Tibial spur of middle leg about as long as the basitarsus. Hind tibiae with one very long spur paired with a short spur.

Length about 1.0 mm.

Male.—Frontovertex yellow; face and cheeks lustrous, pearly white. Antennae yellow. Occiput, pronotum, mesoscutum, axillae, metanotum, propodeum, abdomen except apex, proepisterna, prepectus and mesopleura blackish to dark brown; remainder of the body yellow. Legs mostly pale yellow to whitish, except for the hind coxae, which are dark. In the single specimen at hand, it is difficult to see the coloration of the middle coxae which may be dark. Hind tibiae a trifle dusky toward the base.

Antennae as shown in Figure 154.

Fore wings with a longer marginal fringe and fewer cilia on the disk than in the female. Also, the arrangement of the cilia differs in this sex.

In the male as well as the female there is only one seta on either lateral margin of the mesoscutum located anteriorly. Frontovertex with short, moderately coarse, black setae which are not apparent in the female.

Scutellum proportionately longer than that of the female.

Length about 0.52 mm.

Type.—Cat. No. 42083, U.S.N.M.

Described from five females and one male (holotype, allotype, and paratypes) mounted in balsam. One female, holotype, "Ex. *Ceroplastes* sp. on 'umkavoti,' Durban, Natal, Sept. 10, 1925;" one male, allotype, "Ex. *?Chrysomphalus* sp., Amanzimtati, Natal, May 28, 1927;" four females dismembered and crushed, "On window, Durban, Natal, Sept. 14, 1925." All specimens collected by E. W. Rust. Rust's Nos. C–13, C–13A, and C–13D.

45. COCCOPHAGUS PULCINI Girault

Plate 8, Figure 52; Plate 10, Figure 79; Plate 11, Figure 134

Coccophagus pulcini GIRAULT, New Pests from Australia, III; Brisbane, Queensland, August 25, 1926. (Published by author.)

Girault's original description follows: "As *triguttatus* but abdomen above with 5 distinct cross stripes, 2–4 close; funicle 1 somewhat longer than wide, equal 2, latter shorter than pedical. Wynnum, 4. October, 1921."

The type female is badly crushed but all the fragments are present. The distinct cross stripes mentioned by Girault are no longer apparent. General color light lemon yellow with concealed center of pronotum black. Some blackish appears on abdomen but the sclerites are so badly separated and crushed as to make the original color pattern impossible of recognition.

An antenna is well preserved and intact so that the general shape and proportion can be pictured (fig. 52.) Scape fusiform, of usual shape. Pedicel plainly longer than wide, and longer and wider than first funicle joint. First funicle joint the smallest, the two succeeding subequal in length and slightly increasing in width distad. Club as long as funicle joints combined and about one and one-third times as long as distal funicle joint. The sensoria and vestiture as shown in Figure 52.

Fore wings as shown in Figure 79. Posterior, basal hairless area separated from the hairless streak under the marginal vein by three rows of cilia. Submarginal vein slightly longer than marginal vein; stigmal and postmarginal as shown in Figure 134. Disk of wing with medium sized cilia. Marginal fringe of normal length. Wings clear, hyaline.

Scutellum in the crushed condition plainly wider than long. Ovipositor shortly exserted.

Setae on the body not readily seen and many misplaced by the mutilation. The setae are light-colored, and the scutellum is probably furnished with three pairs of bristles although only the apical pair remain. Mesoscutum with 30 or more moderately stout setae.

Mandibles with the ventral tooth well differentiated from the broad trucation.

Basitarsus of middle legs about as long the three succeeding joints combined; tibial spur about as long as the basitarsus.

Measurements in mm.: Fore wing, length 0.66; greatest width 0.032. Length of marginal vein 0.16; length of submarginal 0.22. Length of marginal fringe 0.0192. Middle legs, length of tarsi 0.16; length of basitarsus 0.0576; length of tibial spur 0.0696. Ovipositor sheaths exserted 0.04 beyond apex of abdomen; however, this may be a distortion. Scape 0.1244 long by 0.0304 wide. Pedicel 0.0456 long by 0.0280 wide. First funicle joint 0.0304 long by 0.0224 wide; second 0.0360 long by 0.03128 wide; third 0.0368 long by 0.0360 wide. First club joint 0.0440 long by wide; second 0.040 long by 0.0480 wide; third 0.0304 long by 0.0296 wide.

Redescribed from the type female in the Queensland Museum. No data on slide label other than name and designation "Female type."

46. COCCOPHAGUS AURICAPUT Girault

Plate 8, Figure 53; Plate 11, Figure 102

Coccophagus auricaput GIRAULT, Memoirs Queensland Museum, vol. 4, 1915, p. 49.

This species must be recognized mainly from Girault's original description. The body of the type female is squeezed out from under the cover glass and is obscured in the excess of balsam. The head is crushed and in fragments on the slide. It is possible to observe some characters of taxonomic value not mentioned in the original description.

Scutellum transverse and furnished with three pairs of bristles.

Mandibles with a distinct ventral tooth and a broad truncation.

Antennae. Scape not seen. Pedicel plainly longer than wide and as long as first funicle joint. Funicle joints very slightly increasing in length distad, almost subequal in length and width, and about twice as long as wide. Club about as long as funicle joints combined and not much wider than distal joint. A drawing of a portion of one antenna is shown in Figure 53. The apical funicle joint and the club of the other antenna remain on the slide and they differ slightly from those figured in that the first two club joints are plainly wider than the apical funicle joint.

The following quotation from the original description pertains to characters no longer discernible. "Orange yellow, the abdomen black, the legs lemon yellow except the dusky hind coxae. Antennae lemon yellow. * * * Fore wings densely, finely ciliate, the stigmal vein short, sessile (fig. 102). Hind wings acutely pointed with about eight lines of fine discal cilia where widest. * * * Wings hyaline.

"From one female taken in forest, January 4, 1912.

"Habitat: Capeville (Pentland), Queensland.

"Type: No. HG/2927. Queensland Museum, Brisbane, the specimen on a slide * * *."

Measurements in mm.: Pedicel 0.0376 long by 0.0256 wide. First funicle joint 0.0376 long by 0.0240 wide; second funicle 0.0432 long by 0.0224 wide; third joint 0.048 long by 0.032 wide. First club joint 0.0408 long by 0.0232 wide; second 0.0384 long by 0.0248 wide; third 0.0488 long by 0.0232 wide.

Redescribed from the type female, Queensland Museum. No data on slide label other than name, designation type female, and museum number.

47. COCCOPHAGUS OCHRACEUS Howard

Plate 8, Figure 54; Plate 10, Figure 81; Plate 11, Figure 123

Coccophagus ochraceus Howard, U. S. Dept. Agr. Div. Ent. Tech. Bull. No. 1, 1895, p. 38.

Coccophagus bifasciaticorpus Girault, Soc. Ent., vol. 31, 1916, p. 44.

Coccophagus ochraceus Gahan, Proc. U. S. Nat. Mus., vol. 56, art. 4, 1924, p. 13.

Female.—Ochraceous to honey yellow with conspicuous dark-brown or blackish markings that are decidedly variable in extent and degree. The blackish to brownish markings are as follows: A broad band across dorsum on apical half of abdomen, a small median spot between cercal plates, a transverse area across center of occiput, collar of pronotum, anterior margin of mesoscutum, notal sutures more or less, axillae in some specimens more or less, metanotum, propodeum, and a blotch on metapleura below. The outer aspect of tibiae and apical tarsal joints slightly suffused with dusky. Eyes bright red. On dorsum of head, orbits paralleled by a narrow iridescent white margin which expands below on the cheeks.

Frontovertex about one and one-third times as wide as long. The posterior ocelli several times their own diameter from the eye margins and not quite as distant from the occipital margin. Frontovertex slightly punctate reticulate. Mesoscutum and scutellum finely reticulated.

Scape slightly fusiform, slender, slightly more than five times as long as wide, and about as long as funicle joints. Pedicel noticeably longer than first funicle joint, a trifle more than twice as long as wide. Funicle joints asymmetrical, ventral side longer, dorsal margin obliquely shortened at apex; all ventrally articulated. First funicle joint plainly the smallest, slightly less than twice as long as wide; second a trifle the longest, but the difference in length between this joint and third hardly appreciable without actual measurement; second slightly more than twice as long as wide; third a trifle shorter than second and appreciably wider so that it is about one and three-fourths times as long as wide. Antennae strongly

clavate. First club joint almost as wide as long and a trifle shorter but plainly wider than third funicle joint; second and third equal in length, second a trifle wider than first, and third narrower (fig. 54).

Scutellum plainly wider than long (5:3) and not so long as mesoscutum (3:5). Abdomen slightly longer than wide, about as wide as thorax and not quite so long. Ovipositor sheaths shortly exserted.

Cheeks with a row of small, dark setae extending downward from eyes and a few setae of lighter color and not so closely placed, scattered between scrobes. Mesoscutum with numerous, scattered, short, black setae and with the two setae near the mesoscutar-scutellar suture appreciably the largest. Each axilla with two strong setae. Scutellum with three pairs of strong black bristles.

Fore wings hyaline, veins yellowish. Marginal vein plainly longer than submarginal; postmarginal shortly produced; stigmal as shown in figure 123. Disk of wings finely and densely ciliated with a characteristic row of cilia as shown in Figure 81. Marginal fringe of moderate length.

Length of average-sized specimens 0.8 mm.

Male.—The antennae of the male are different from those of the female. The coloration is also somewhat different. As a rule the dark coloration is more extensive and intensive, the antennae are fuscous, and the legs have more dusky.

Antennal club not differentiated. Scape slender. Pedicel short, as wide as long. Flagellar joints gradually decrease in width, the apical joint somewhat more than one-half as wide as the first; first five joints subequal in length. Flagellum with numerous sensoria.

Redescribed from numerous specimens reared from *Saissetia oleae* (Bernard), collected by E. W. Rust at Cape Town, South Africa, and from specimens collected in southern California.

48. COCCOPHAGUS FLETCHERI Howard

Coccophagus fletcheri HOWARD, U. S. Dept. Agr. Bur. Ent. No. 7, 1897, p. 63.

This species is known to me only by the original description.

49. COCCOPHAGUS NIGRITUS, new species

Plate 5, Figure 9; Plate 8, Figure 55; Plate 11, Figure 121; Plate 14, Figure 179

This species resembles *C. modestus* var. *capensis* Silvestri from which it is separated by the differently shaped abdomen, longer ovipositor, fainter infuscation of the fore wings, and coloration of the head. In this species, the ovipositor arises near the base of the abdomen while in *C. modestus* Silvestri it arises near the middle.

Mr. Rust, who observed the behavior of these parasites in life, wrote that they walked differently from *C. modestus* var. *capensis*.

Female.—Thorax and abdomen black. Frontovertex, face, and a part of the cheeks ferrugino-testaceous and usually with some fuscous in parts, the fuscous pronounced on the posterior part of the cheeks. Antennae testaceous. Legs blackish or dark brown except as follows: Apices of all femora and an annulus at base of the middle pair, fore tibiae, middle tibiae at ends, and tarsi except the apical joints, the latter pallid in balsam mounts, in life probably white or faintly yellowish white.

Pedicel about one and one-half times as long as wide. First funicle joint slightly more than twice as long as wide and about twice as long as the pedicel; second and third successively shorter and wider, the third only a trifle longer than wide. Club short and wide, only slightly longer than the first funicle joint; all joints wider than long, the first and second very much wider than long. Antennae as in Figure 55.

Mandibles as shown in Figure 179.

Fore wings with an indefinite infuscated area beneath the apical half of the marginal vein. Marginal vein almost one and one-half times as long as the submarginal; postmarginal slightly variable, sometimes produced as far distad as the stigmal. Postmarginal and stigmal veins as in Figure 121.

Proportions, shape, and vestiture of thorax and abdomen as in Figure 9.

Middle femur with a strong black spine at apex and middle tibia with smaller but conspicuous spines at base. Hind tibia with the dorsal margin furnished with strong, suberect spines. Middle tibial spur slightly shorter than the basitarsus. Hind tibia with two strong, subequal spurs.

Length 2.08 mm.

Type.—Cat. No. 42097, U.S.N.M.

Described from 17 females (holotype and paratypes) reared by E. W. Rust from *Saissetia persimile* (Newstead) collected at Durban, Natal, February and March, 1927. The specimens are all mounted in balsam and 12 of them are dismembered and partly flattened.

50. COCCOPHAGUS MODESTUS Silvestri

Plate 8, Figure 56

Coccophagus orientalis var. *modesta*, SILVESTRI, Boll. Lab. Zool. Agr., Portici., vol. 9, 1914, pp. 355–57.

In this paper, the name *C. modestus* Silvestri is restricted to the form occurring at Dahomey, Cotonou. There is uncertainty as to whether the form occurring in Cape Town and Durban is specifi-

cally identical with the Dahomey form as heretofore supposed. Doctor Silvestri kindly loaned two female cotypes for study. The type specimens differ from the South African specimens by having the antennae thicker (Figs. 56, 57), the spurs at apex of hind tibiae slightly unequal, setae of the mesocutum a trifle coarser, two conspicuous setae on either side of the first tergite, microscopic markings on the sides of the third tergite, as well as on the fourth and fifth, and the outer plates of the ovipositor slightly proportionately wider and shorter.

51. COCCOPHAGUS MODESTUS Silvestri var. CAPENSIS, new variety

Plate 9, Figure 57; Plate 14, Figure 176

Coccophagus modestus SMITH and COMPERE, Univ. Calif. Pub. Ent., vol. 4, No. 3, 1926, pp. 51–61, 2 figs.

The South African form previously treated by us under the name *C. modestus* is here tentatively classed as a new variety as there is uncertainty regarding its identity. Our earlier description applies to this form[31] and not to typical *C. modestus.*

Type.—Cat. No. 42105, U.S.N.M.

In the Rust collection there is a good series of specimens reared from *Saissetia oleae* (Bernard) collected at Cape Town, South Africa, and from *Saissetia persimile* (Newstead) collected at Durban, Natal, South Africa. The holotype is from Cape Town.

52. COCCOPHAGUS NUBES Compere

Plate 6, Figure 12; Plate 9, Figure 58; Plate 11, Figure 86

Coccophagus nubes COMPERE, Univ. Calif. Pub. Ent., vol. 4, No. 9, 1928, pp. 257–58.

This is a distinctive species of medium size. Head, dorsum of thorax except metanotum and propodeum, and basal abdominal segment yellow to orange or fulvous. Metanotum, propodeum, and abdomen except base black. Fore wings with a smoky cross band under the apical portion of marginal vein. Scutellum densely setose. Postmarginal vein wanting.

Female.—Face and cheeks pale brownish yellow; frontovertex yellow to fulvous; occiput mostly black. Antennae about concolorous with face, sensoria blackish. Eyes chocolate. Ocelli dark red. Concealed portion of pronotum blackish, exposed portion more or less concolorous with the mesoscutum. Mesoscutum, scutellum, median piece of metanotum, axillae and prepectus mostly yellowish, the mesoscutum slightly paler without dilute reddish or orange which slightly suffuses scutellum, axillae, and parapsides. Mesopleura and most of sternum blackish. Metanotum except median piece, propo-

[31] Univ. Calif. Pub. Ent., vol. 4, No. 3, 1926, pp. 50–61.

deum, and abdomen except for basal segments, black. Basal abdominal segments yellow. Fore and middle legs mostly straw-colored to pale yellow. Femora of fore legs on outer aspect at base with some fuscous. Femora and tibiae of hind legs mostly blackish, the extremities yellowish. Apical tarsal joints faintly brownish. Ovipositor sheaths, as seen from beneath, brownish.

In the tag-mounted specimens, the head is shriveled, face deeply sunken and frontovertex folded. Antennal sockets with their upper margin about tangent to basal ocular line and spaced about as far apart as they are above oral margin. Cheeks without discernible suture. Posterior ocelli less than their own diameter from eye margins and about the same distance from occipital margin. Posteriorly the eyes contiguous with occipital margin.

Antennal scape of usual shape, slightly fusiform, about four times as long as wide. Pedicel about one and one-half times as long as wide and distinctly shorter than the first funicle joint. First funicle joint slightly longest, slightly more than one and one-half times as long as wide; following funicle joints successively very slightly shorter and wider, the third only slightly longer than wide. Club as seen in tag mounts slightly wider than funicle. In the balsam mount the antenna is oriented so that the club appears slightly narrower than the funicle (fig. 58).

Mandibles broad and truncate at apex, the margin very slightly and indistinctly incised.

Scutellum a trifle wider than long and as long as mesoscutum. Spiracles slightly oval, almost rotund. Abdomen of moderate size; in tag-mounted specimens after shrinkage, longer than wide and not as long as thorax. Ovipositor concealed. In the cleared balsam-mounted specimen, the ovipositor is seen to be less than one-half as long as the abdomen (fig. 12).

Fore wings with an infuscated area under distal half of marginal vein. Marginal vein longer than submarginal; postmarginal vein absent; stigmal as shown in Figure 86. Ciliation of the disk slightly coarse on basal half and moderately dense.

Mesoscutum clothed with numerous short, black setae arranged in somewhat irregular, longitudinal files; setae on lateral and posterior margins stronger and about same size as the two setae located on each axilla. Each parapsis with three setae. Scutellum about as densely setose as mesoscutum and with a pair of long apical bristles. Middle femur at apex beneath with a strong black spine and a few smaller pale spines; base of the tibia with a few short spines. Eyes with short fine setae. Face and cheeks with yellowish setae, those on the frontovertex slightly stronger and blackish.

Measurements in mm.: Length 1.3. Scape 0.1352 long by 0.0336 wide. Pedicel 0.0520 long by 0.0344 wide. First funicle joint

0.0580 long by 0.04 wide; second 0.0568 long by 0.0424 wide; third 0.0512 long by 0.0448 wide. First club joint 0.0488 long by 0.0424 wide; second 0.0464 long by 0.0416 wide; third 0.0456 long by 0.0320 wide.

Redescribed from the original description and from specimens compared with the types. According to E. W. Rust, the species was reared from *Saissetia oleae* (Bernard) and *Saissetia persimile* (Newstead) on *Chaetachme aristata*, Berea, Durban, August 25, 1925; and from *Saissetia perseae* Brain, September 3, 1925, and from *Coccus hesperidum* Linnaeus. On various hosts at later dates. Also from an undetermined species, a bluish or blackish *Ceroplastes* sp., on *Ficus natalensis*.

53. COCCOPHAGUS SAINTEBEAUVEI Girault

Plate 9, Figure 65; Plate 11, Figure 118

Coccophagus saintebeauvei GIRAULT, Descriptiones Stellarum Novarum, Wash., D. C. (Published by author), 1917, p. 1.

A moderately large species with the wings infuscated beneath the marginal vein. Body black except the extreme apex of scutellum and median piece of metanotum which are yellow. Scutellum densely setose. Hind femora pure pale yellow in striking contrast. Structurally this species is probably most closely related to *C. malthusi* Girault.

Female.—Body black except very narrowly around the apical curvature of the scutellum and the median piece of metanotum which is lemon yellow. Dorsum of the head with the posterior triangular corners yellow to brownish orange; face somewhat brownish, remainder of the head black except for the pattern of lines margining the ocelli. Antennae brownish, the flagellum more dusky because of the numerous black sensoria. All coxae blackish or dark brown. Femora of fore and middle leg blackish, becoming brownish at the apices; middle femora with a brownish annulus at the base; hind femora pale lemon yellow, the trochanters more sordid. Fore and middle tibiae brownish yellow, the former somewhat more dusky because of the clothing of black hairs; hind tibiae blackish, becoming brownish at the extreme apex. All tarsi brownish yellow, the apical joints a trifle dusky.

Pedicel plainly longer than wide and plainly shorter than the first funicle joint. First funicle joint the longest, somewhat more than twice as long as wide; second and third successively shorter and wider; third plainly longer than wide, in this respect not in agreement with the original description. First club joint wider than long and shorter than the preceding funicle joint (fig. 65).

Scutellum slightly wider than long (5:4) and not quite as long as the mesoscutum. Abdomen not quite twice as long as wide and about as long as the thorax. Ovipositor shortly exserted.

Fore wings distinctly infuscated beneath the marginal vein; densely and coarsely ciliated with a short marginal fringe. Marginal vein much longer than the submarginal; postmarginal shortly produced as shown in Figure 118.

Face and cheeks rather coarsely areolate reticulate, a trifle coarser than that of the mesoscutum. Mesoscutum and scutellum with the usual areolate reticulations. Frontovertex punctulate reticulated. The median carina of the propodeum mentioned by Girault is the normal ridge formed by the median line being somewhat elevated, probably as a result of shrinkage. Propodeum mostly obscured by the wings but laterally the reticulations can be viewed; they appear a trifle coarser than usual.

Eyes with microscopic, fine, white pile. Frontovertex with numerous short, black setae, those on the face and cheeks slightly finer. Mesoscutum with numerous dark setae. Scutellum, except approximately the apical one-fourth, with setae about as numerous as those of the mesoscutum; apex of scutellum with a pair of moderately long, pale bristles, and a second preapical pair about half as long located at the posterior margin of the setose area. Each axilla apparently with two setae similar to those of the mesoscutum and each parapsis with about four similar setae.

Tibial spur of middle legs shorter than the basitarsus. Paired spurs at apex of hind tibiae partially concealed.

Girault states that the species is robust. As compared to the other large, or medium-sized species, this form is not robust, being more closely related to *C. malthusi* and its allies than to the shorter, more robust species such as *C. anthracinus*, *C. modestus*, etc.

Measurements in mm.: Length 1.5. Pedicel 0.0640 long by 0.0432 wide. First funicle joint 0.1144 long by 0.0480 wide. Second 0.0904 long by 0.0568 wide; third 0.0784 long by 0.06 wide. First club joint 0.0544 long by 0.0672 wide; second 0.0504 long by 0.0656 wide; third 0.0552 long by 0.0472 wide. Fore wings 1.04 long by 0.48 wide. Marginal vein 0.38 long; submarginal 0.28 long. Longest marginal fringe 0.0368.

Redescribed from one female (paratype) U.S.N.M. No. 20074, reared from *Saissetia oleae* (Bernard), September, 1925, Nagunga, Uganda, South Africa, C. C. Gowdey.

54. COCCOPHAGUS SPECTABILIS, new species

Plate 4, Figure 6; Plate 9, Figure 60

A large, robust species; body black with a yellow spot on either side of the first tergite: head yellow. Structurally suggestive of *C. modestus Silvestri*. Fore wings infuscated.

Female.—Head yellow except that the concealed part of the occiput and a blotch contiguous to the mesal margin of each lateral ocellus are black. Antennae yellow with a touch of fuscous suffusing the dorsum of the pedicel. Mentum, stipes, and palpi more or less fuscous. Thorax usually shining black with the margins of the sclerites in proximity to the insertion of the fore wings edged with yellow and the tegulae and median piece of metanotum yellow. Abdomen shining black with the basal corners marked with sharply defined, angular yellow spots. All coxae mostly, if not completely, black. All trochanters more or less yellow. Fore and middle femora black with yellow apices; hind femora entirely black. Fore tibiae mostly if not entirely yellow; middle and hind tibiae black, the latter pale or yellow at apices. Tarsi yellow to whitish, apical joints dusky.

Pedicel one and one-half times as long as wide and about one-half as long as the first funicle joint. First funicle joint the longest, a trifle more than twice as long as wide; second and third only slightly longer than wide. Club short and wide, the three joints united are not much longer that the first funicle joint; all club joints plainly wider than long. Antennae similar to those of *C. modestus* Silvestri and *C. speciosus*, new species (fig. 60).

Mandibles almost edentate, the apical tooth small.

Fore wings with a distinct infuscated area beneath the apical third of the marginal vein; cilia of disk normal. Marginal vein slightly longer than the submarginal; postmarginal shortly but distinctly produced.

Scutellum wider than long (20:17) and as long as the mesoscutum. Ovipositor extending about two-thirds the length of abdomen, not exserted.

Frontovertex with numerous rather coarse black setae, those on cheeks and upper part of face smaller and pale. Clypeus with coarse, strong, black setae, larger than those of the frontovertex. Mesoscutum with dense, coarse, black setae, those along the lateral and posterior margins twice as large as the others. Each parapsis with four setae. Each axilla with two or three setae. Scutellum, except the apical one-fourth, about as densely setose as the mesoscutum, the apex furnished with a very strong pair of setae and a preapical pair about one-half as strong. The rows of setae incomplete across the second and third tergites. Fourth, fifth, sixth, and seventh tergites each with black setae entirely across the dorsum. Middle femur with a stout seta at apex. Middle tibia with five stout black setae at base. Outer aspect of hind tibia furnished with stout black setae, the paired spurs at apex large and of equal size.

Mesoscutum, scutellum, axillae, median part of propodeum, and blackened part of abdomen appear rather closely and heavily reticulated in the balsam-mounted specimens studied.

Length 1.8 mm.

Male.—Unknown.

Type.—Cat. No. 42087, U.S.N.M.

Described from 12 females (holotype and paratypes), mounted in balsam on slides, reared by E. W. Rust from *Saissetia persimile* (Newstead) collected at Durban, Natal, February, and March, 1927.

55. COCCOPHAGUS SPECIOSUS, new species

In structure this species appears to be similar to the foregoing species, *C. spectabilis.* In coloration it appears so unlike *spectabilis* as to warrant its tentative description as a new species. It is possible that a large series of specimens may reveal intergrading forms that will necessitate synonymizing the name *speciosus.*

Female.—It is in the coloration of the legs that this form shows such a marked difference from *C. spectabilis.* The fore and middle legs are entirely pale yellow. Coxae and trochanters of the hind legs are yellow, in sharp contrast to the femora and tibiae which are black. Apical tarsal joints of the middle legs fuscous, the remaining tarsal joints yellowish or pallid.

Except for the differences in the coloration of the parts described above, the figures of *C. spectabilis* and the description of that species will apply equally well to this form.

Male.—Except for the abdomen which is entirely black, the color is similar to that of the female. Wings hyaline, the cilia much finer than that of the female. Antennal proportions and shape of segments similar to that of the female.

Type.—Cat. No. 42088, U.S.N.M.

Described from one female, 17 males, (holotype, allotype, and paratypes) reared by E. W. Rust from *Saissetia persimile* (Newstead), *Filippia carissae* Brain, and *Coccus hesperidum* Linnaeus, collected at Durban, Natal, February, March, August, and September, 1927. It is to be noted that *C. spectabilis* was reared from *S. persimile* collected at the same time and from the same locality as *C. speciosus* which substantiates the suspicion that perhaps the latter is but a color variant.

56. COCCOPHAGUS PRINCEPS Silvestri

Coccophagus princeps Silvestri, Boll. Lab. Zool. Agr. Portici, vol. 9, 1914, pp. 357–59, fig. 16.—Compere, Univ. Calif. Pub. Ent., vol. 4, No. 1, 1926, pp. 6–7.

This species is structurally similar to *C. malthusi* Girault and to *C. clavellatus*, new species.

Female.—Head yellow except for blackish on the occiput above and on either side of foramen. Mesoscutum, scutellum, and median piece of metanotum yellowish, remainder of body black. Hind

femora entirely black; hind tibia black except the apical one-fourth which is yellow and concolorous with the remainder of the legs.

Male.—Body black, head yellow, legs yellow except for fuscous suffusing the basal half of hind tibiae.

For the purposes of comparison, Doctor Silvestri loaned the types for study and Dr. Guy Marshall loaned a series of specimens determined as this species by Ch. Ferrière, labeled: "British Sudan Wad Mehadi, H. B. Johnston, No. 4126, 10/4/1927, Ex. *Ceroplastes africanus* ? on *Acacia arabica.*"

57. COCCOPHAGUS MALTHUSI Girault

Plate 1; Plate 2; Plate 14, Figure 180

Coccophagus malthusi GIRAULT, Descriptiones Stellarum Novarum, Wash., D. C. (Published by author) May, 1917.—COMPERE, Univ. Calif. Pub. Ent., vol. 4, No. 1, 1926, pp. 5–9.

This species has previously been redescribed.[32] An additional series of specimens has been received since the redescription was published. The new specimens were sent by Rust, who said that they were reared from an undescribed dark brown *Ceroplastes* on *Ficus natalensis* collected at Durban, Natal, September 22, 1926. Rust's No. C–18. The great majority of specimens in this series have the body almost completely black, but the parapsides with the posterior margin narrowly marked with orange and the postscutellum yellow. As a rule the dorsum of the head is orange, the face and cheeks yellow suffused with more or less fuscous. The hind femora may be entirely yellow or liberally marked with blackish. As already mentioned this species is extremely variable in coloration, some specimens having the mesoscutum and scutellum brownish. This species, more than any other, illustrates how unreliable is a classification based on color differences.

58. COCCOPHAGUS CLAVELLATUS, new species

Plate 9, Figure 61; Plate 11, Figure 90; Plate 13, Figures 162 and 165; Plate 14, Figure 181

Due to the marked difference in coloration, this form was at first confidently considered to be a distinct species. A more careful study in comparison with specimens of *C. princeps* Silvestri and *C. malthusi* Girault failed to reveal any fundamental structural differences among the three forms and *C. clavellatus* as well as *C. malthusi* may possibly prove to be synonymns. So far as I am aware, the figures given as illustrative of this species equally well represent *C. princeps* and *C. malthusi.*

[32] Univ. Calif. Pub. Ent., vol. 4, No. 1, 1926, pp. 5–9.

Female.—Head, antennae, and thorax pale orange to yellow except for the following parts which are marked with blackish: occiput about the foramen, pronotum except the lateral angles, wedge shaped part of parapsides, axillae more or less, metanotum except median piece, propodeum, mesosternum, mesoepisterna and mesopleura. Sometimes the expanded part of parapsides and tegulae are more or less suffused. Abdomen black; ovipositor sheaths yellow, edged with black. Coloration of coxae variable, usually fore coxae mostly yellow and middle and hind coxae mostly black; hind tibiae more or less black on basal half or more; apical tarsal joints fuscous, remainder of the legs yellow.

Pedicel about one and one-third times as long as wide and not quite one-half as long as the first funicle joint. First funicle joint plainly the longest, a trifle more than twice as long as wide; second and third successively shorter and almost imperceptibly wider so that the third is a trifle more than one and one-third times as long as wide. Club short, the three joints united not much longer than the first funicle joint; basal club joint the largest, almost one and one-half times as wide as long; second and third successively smaller, second plainly wider than long, third almost as wide as long (fig. 61).

Mandibles as shown in Figure 181.

Fore wings hyaline; cilia normal; marginal fringe short. Marginal vein plainly longer than the submarginal; stigmal as shown in Figure 90.

Scutellum only slightly wider than long (6:5) and about as long as the mesoscutum. Abdomen rather long, and slender; seventh tergite long. Ovipositor very long, extending from near the base of the abdomen to beyond the apex, the sheaths projecting 0.08 mm.

Frontovertex with numerous, short, moderately coarse, dark setae, those on face and cheeks fine and pale. Mesoscutum densely setose, the setae moderately coarse, those along the sides and posterior margins not quite twice as large as those on the disk. Each parapsis with five or so setae. Each axillae with two prominent setae anteriorly and usually with a row of five or so smaller setae paralleling the scutellar suture. Scutellum about as densely setose as the mesoscutum, and in addition with a moderately long pair of apical setae and a subapical pair about one-half as long. The setae arranged across the dorsum on the tergites from three to seven inclusive, those on the sixth and seventh tergites scattered. Middle femur with a stout black spine at apex on outer side and base of middle tibia with three smaller yet prominent black spines at base on outer side as shown in Figure 162. Tibial spur slightly shorter than the basitarsus, the basitarsus not quite as long as the succeeding joints

united. Dorsal margin of hind tibia with a row of stout, suberect setae.

Length 1.6 mm.

Male.—Not known.

Type.—Cat. No. 42084, U.S.N.M.

Described from 12 females (holotype and paratypes). Ten specimens reared from *Ceroplastes* sp. on "pop corn" collected at Durban, Natal, by E. W. Rust, August 12, 20, and 27, 1926. One specimen reared from *Ceroplastes destructor*, same locality, August 11, 1926. One specimen reared from *Coccus hesperidum*, same locality, June 18, 1926. Rust's No. C20.

59. COCCOPHAGUS ALBICOXA Howard

Plate 9, Figure 62; Plate 14, Figure 171

Coccophagus albicoxa HOWARD, Journ. Econ. Ent., vol. 4, 1911, p. 276.
Coccophagus coxalis GIRAULT, Ent. News, vol. 27, 1915, p. 34.

The above synonymy should be credited to A. B. Gahan, who furnished the data in private correspondence and authorized its publication.

C. albicoxa Howard is one of the largest and most distinctive species, ranging near 2.5 mm. in length, with distinctive yellowish white hind coxae and elongated abdomen.

Female.—General color black with yellow markings as follows: Apical half of scutellum, metanotum and propodeum except the sides and center. Scape and pedicel dark brown. Hind coxae and trochanters pale yellow; fore and middle coxae black. Fore and middle tibiae brownish or blackish, paler at ends; hind tibiae black. All femora black. Tarsi pallid whitish to brownish, the brownish more pronounced on the fore pair, apical joints dusky.

Scape about as long as pedicel and first funicle joint united. Pedicel longer than wide (4:3) and about one-half as long as first funicle joint. First funicle joint longest, succeeding joints each slightly shorter and a trifle wider. First funicle joint about twice as long as wide; third about one and one-third times as long as wide Club short, hardly as long as two preceding funicle joints united. First club joint longer than wide and slightly wider and slightly shorter than preceding funicle joint; second wider than long; third slightly longer than wide (fig. 62).

Mandible with two ventral teeth only slightly developed and a board truncation as shown in Figure 171.

Fore wings hyaline. Marginal vein plainly longer than submarginal; stigmal broad, only slightly constricted at base; postmarginal not extending distad quite so far as stigmal. Cilia of disk rather coarse and sparse on basal half and much finer toward apex. Marginal fringe short.

Basitarsus of middle legs about as long as succeeding three joints united; tibial spur plainly shorter than basitarsus. Paired tibial spurs of hind legs slightly unequal.

Scutellum about as long as wide and as long as mesoscutum. Abdomen elongate, twice as long as wide, as long as thorax, pointed at apex; seventh tergite elongate, but wider than long (17:14). Ovipositor long, slightly exserted, as seen through the derm in balsam-mounted specimens arising a short distance from base of abdomen.

Mesoscutum and scutellum densely setose, the scutellum in addition with a pair of strong apical bristles at apex. Each axilla with two setae on anterior margin. Frontovertex and cheeks with numerous coarse, short, black setae, those on former set in setigerous punctures. Eyes with extremely fine, pale, almost imperceptible hairs. Anterior margin of metanotum on either side with four small setae. Propodeum with a group of fine, dusky or pale setae on either side laterad of the spiracles. Abdomen with rather numerous black setae; first and second tergites with incomplete transverse rows of setae across dorsum; setae on following tergites more numerous and scattered and extending entirely across dorsum. Base of middle tibia with a group of about five stout setae or bristles; the tibia more setose than usual. Hind tibia on dorsal margin with a row of moderately coarse setae.

Mesoscutum, axillae, and scutellum rather strongly reticulated, the reticulations on the sides of the axillae longitudinally lengthened. Face and cheeks strongly reticulated. Frontovertex reticulated and impressed with numerous setigerous punctures. Metanotum on either side with a longitudinal carina and three short, transverse carinae. Propodeum on either side with longitudinal carina mesad of the spiracles. Basal abdominal tergite mostly smooth and shining, the following closely reticulated.

Length 2.5 mm.

Redescribed from 8 females reared from *Physokermes insignicola* (Craw) on *Pinus radiata* collected at Santa Maria, Calif., by R. C. Wylie, May 14, 1912.

60. COCCOPHAGUS MEXICANUS Girault

Coccophagus mexicanus GIRAULT, Ent. News, vol. 27, No. 1, 1915, p. 34.

I have not seen this species. In reply to an inquiry, A. B. Gahan wrote as follows: "I have reexamined *C. mexicanus* Girault and hope that you will be able to place it in your key from the following notes: *C. mexicanus* is extremely like *C. albicoxa* Howard but differs by having the propodeum entirely black, the frons and face brownish yellow, the vertex similarly colored but darker, the occiput, temples, and cheeks black, and apical one-fourth of the scutel-

lum yellow. Resembles *C. saissetiae* Gahan but the head is much darker and the legs are quite differently colored, the hind coxae and trochanters white, fore and median tibiae fusco-testaceous, all tarsi testaceous, the rest of legs black. This may be but a variant of *C. albicoxa* but the two known specimens agree in the above cited color characters and since the form is easily recognized so far as present material is concerned it should be retained."

This form was reared from a lecaniine scale collected in Panama.

61. COCCOPHAGUS NIGER Masi

Coccophagus niger Masi, Boll. Lab. Zool. Gen. Agr., Portici, vol. 4, 1909, pp. 35–36.

This species was described by Masi from specimens reared from *Lichtensia viburni* collected at Portici. I have not seen samples of this species. The following species, *C. mexicensis* Girault, is in agreement with the original description of *C. niger* Masi, and may prove to be a synonym.

The following note is extracted from the original description: General color black. Frontovertex with dull yellow bands. Coxae and femora black; fore femora on apical third and fore tibiae dusky yellowish; apices of other femora and corresponding tibiae sulphur yellow; tarsi rusty. Antennae dusky yellowish. Wings faintly dusky. Scutellum setose with longer bristles at apex.

62. COCCOPHAGUS MEXICENSIS Girault

Plate 9, Figure 63; Plate 11, Figure 96; Plate 13, Figure 157

Coccophagus mexicensis Girault, Descriptiones Stellarum Novarum (published by author), Wash., D. C., 1917, p. 2.

A robust, black species of medium size, without any striking characters aside from the coloration of the legs. Wings very faintly and uniformly infuscated, appearing iridescent in tag mounts. Scutellum densely setose. This species can not be separated from *C. niger* Masi on the basis of Masi's original description.

Female.—Head, thorax, and abdomen mostly black, sides and underparts brownish black. All femora blackish to dark brown, the middle pair slightly but noticeably paler at apices and with a brownish annulus at base. Tibiae of middle and hind legs pale yellow to whitish, those of the fore legs brownish. All tarsi pale yellow or whitish to slightly brownish yellow, middle tarsi the palest, fore tarsi the brownest; remainder of legs dark brown to blackish.

The antennae of the only female available for study are shriveled. Pedicel short, not much longer than wide, plainly much shorter than first funicle joint. First funicle joint longest, described by Girault as being twice longer than wide but is apparently less than twice as long as wide. Second and third funicle joints each very slightly,

successively shorter and wider than first, all longer than wide. Basal club joint not as long as third funicle joint and wider. All club joints subequal in length (fig. 63). The figure of the antenna may not be entirely accurate as the specimen from which the drawing was made was considerably distorted.

Measurements in mm.: Length 1.25. Scape 0.16 long by 0.0320 wide. Pedicel 0.0448 long by 0.0328 wide. First funicle joint 0.0784 long by 0.0504 wide; second 0.0760 long; third 0.0640 long by 0.0544 wide. First club joint 0.0496 long by 0.0584 wide; second 0.0456 long by 0.0560 wide; third 0.0480 long by 0.0408 wide. Fore wings 1.08 long by 0.52 wide. Marginal vein 0.28 long; submarginal 0.32 long. Longest marginal fringe 0.0280.

Redescribed from 1 female (paratype) U.S.N.M. No. 20078, Mexico, Koebele, Coll.

63. COCCOPHAGUS YOSHIDAE Nakayama

Plate 6, Figure 14; Plate 9, Figure 74; Plate 11, Figure 100; Plate 14, Figure 169

Coccophagus yoshidae NAKAYAMA, Philippine Journ. Sci., vol. 18, No. 1, 1921, pp. 98–99, pl. 1, fig. 1.—COMPERE, Bull. So. Calif. Acad. Sci., vol. 23, pt. 4, 1924, p. 119.

A large black species with hyaline wings and densely setose scutellum.

Female.—Head and body wholly black, sometimes the face suffused with brownish. Antennal scape with some brownish, pedicel and flagellum darker. Legs black, marked with pale yellow as follows: fore and middle tibiae entirely; fore and hind femora narrowly at apex. The light-colored portions of the fore legs with a trace of brownish; tarsi yellowish except the apical joints, which are dusky; middle femora with a faint brownish annulus at base.

Antennal scape a trifle wider than usual, hardly more than three times as long as wide. Pedicel about one and one-half times as long as wide and plainly much shorter than the first funicle joint, which is almost twice as long as wide. Second and third funicle joints almost imperceptibly decreasing in length and increasing in width so that the third is only about one and one-sixth times as long as wide. Basal club joint plainly but slightly wider than long, plainly shorter than third funicle joint and slightly wider; second club joint also wider than long; third as long as wide (fig. 74).

Mandibles slightly incised, with a ventral tooth and a broad, dorsal truncation (fig. 169).

Scutellum a trifle wider than long and about as long as mesoscutum. Abdomen about as long and as wide as thorax. Ovipositor sheaths not exserted. Figure 14 is drawn with the first tergite too short.

Frontovertex with numerous short, black setae, those on face and checks finer and sometimes paler. Mesoscutum with numerous short, black setae. Scutellum except apex about as densely setose as mesoscutum. Apical portion of scutellum without the small setae but with a strong pair of bristles. Size and arrangement of setae as shown in Figure 14. Each axilla with two strong setae. Each parapsis with four strong setae.

Mesoscutum and densely setose portion of scutellum slightly more coarsely reticulated than is usual in *Coccophagus*.

Fore wings hyaline; densely and closely ciliated, the posterior portion in an area beneath the base of the marginal vein with cilia finer and pale, almost evanescent. Marginal vein plainly longer than the submarginal; postmarginal produced distad a trifle farther than the stigmal; stigmal shown in Figure 100.

Measurements in mm.: Length of average-sized specimen 1.6. Scape 0.1404 long by 0.0464 wide. Pedicel 0.0656 long by 0.0440 wide. First funicle joint 0.1104 long by 0.0560 wide; second 0.0792 long by 0.0560 wide; third 0.0736 long by 0.0640 wide. First club joint 0.0560 long by 0.0656 wide; second 0.0528 long by 0.0624 wide; third 0.0488 long by 0.0448 wide.

Described from many female specimens collected in Japan by Clausen and Ishii. Specimens received from Clausen issued from *Coccus hesperidum* Linnaeus and *Coccus pseudomagnoliarum* (Kuwana), collected at Yokohama, June 1922. Specimens received from Ishii issued from *Coccus hesperidum* Linnaeus collected at Nagaski.

The determination of this species was made by Gahan and Timberlake. Gahan made his identification after comparison with paratypes in the United States National Museum.

This is a primary parasite and an effort was made to establish it in California. In captivity, females were seen to oviposit in *Saissetia oleae* (Bernard) but no progeny were obtained.

64. COCCOPHAGUS GOSSYPARIAE Gahan

Coccophagus gossypariae GAHAN, Proc. U. S. Nat. Mus., vol. 71, art. 4, 1927, p. 24.

This species can be recognized on the basis of Gahan's original description. Related to *mexicensis* Girault and *quaestor* Girault, from which it can be distinguished by different coloration of the legs.

Female—Scutellum setose. Body entirely black. All coxae mostly black. Hind femora black, remainder of the legs mostly pale yellow to whitish; only tarsi of fore legs and apical tarsal joints of middle and hind legs dusky. Wings hyaline.

65. COCCOPHAGUS ACANTHOSCELES Waterston

Coccophagus acanthoceles Waterston, Bull. Ent. Res., vol. 7, 1916, p. 141, fig. 3.

Specimens of this species have not been available for study. The original description is very precise and there should be no difficulty in recognizing this species. It differs from all other predominantly blackish species by having the pedicel longer than the first funicle joint (10:7).

66. COCCOPHAGUS ROBUSTUS, new species

Plate 5, Figure 8; Plate 9, Figure 64; Plate 11, Figure 122; Plate 13, Figures 160, 161

This species is most closely allied to *C. modestus* Silvestri, *C. spectabilis*, new species and *C. speciosus*, new species from which it is easily separated by the hyaline wings, different antennal proportions, and absence of stiff, coarse, suberect setae on the dorsal margin of the hind tibiae.

Female.—Frontovertex orange yellow; face and cheeks similarly colored except for more or less fuscous suffusions which are more pronounced on the latter. Antennae yellow with dusky sensoria. Occiput mostly blackish. Thorax and abdomen black except the median piece of the metanotum, which is yellow in sharp contrast. Legs mostly black marked as follows with a variable amount of yellow: apices of fore femora, ends of middle femora, apices of hind femora, fore tibiae more or less generally, middle tibiae narrowly at bases. Tarsi pallid with more or less dusky.

Pedicel almost one and one-half times as long as wide, plainly shorter than the first funicle joint. First funicle joint the longest, about one and one-fourth times as long as wide; second and third successively decreasing in length and increasing in width so that the third is about one and one-half times as wide as long. The thick third funicle joint is a good character for the recognition of this species. First club joint subequal to the two following joints and to the third funicle joint (fig. 64).

Fore wings hyaline; cilia rather dense and coarse. Marginal vein plainly longer than the submarginal; stigmal as shown in Figure 122.

Scutellum slightly wider than long and about as long as the mesoscutum. Abdomen apparently as long and as wide as the thorax, broadly rounded at the apex. General proportions of body as shown in Figure 8.

Frontovertex with numerous, short, black setae. Setae of thorax and abdomen as shown in Figure 8. Apex of middle tibia with one long, curved black seta (fig. 161). Apex of hind tibia with a pair of subequal strong setae beneath and a pair about one-half as strong on the dorsum (fig. 160).

Length 1.2 mm.

Type.—Cat. No. 42096, U.S.N.M.

Described from 19 females (holotype and paratypes) mounted in balsam; 14 of the specimens with appendages dissected and body sclerites separated. Reared by E. W. Rust from *Saissetia persimile*, February and March, 1927, Durban, Natal, South Africa. Rust's No. C–33.

67. COCCOPHAGUS QUAESTOR Girault

Plate 9, Figure 59; Plate 11, Figure 94; Plate 13, Figure 156

Coccophagus quaestor GIRAULT, Descriptiones Stellarum Novarum. (Published by author.) Wash., D. C., 1917, p. 2.

A robust, black species of medium size, most easily distinguished from the closely related *C. mexicensis* Girault by different coloration of the tibiae, which in this species are dark brown. This species and *C. mexicensis* are of a more robust type than is *C. immaculatus*, to which they are compared by their author. Fore wings faintly, uniformly infuscated. Scutellum densely setose.

Female.—Head, thorax, and abdomen mostly black, becoming dark brown on sides and under parts. Legs dark brown to blackish except as follows: middle femora at ends pale, fore tibiae pale, all tarsi yellowish to whitish, apical tarsal joints slightly brown, middle tibiae very slightly pale at ends. Antennae brown.

Pedicel short, about as wide as long, much shorter than first funicle joint. First funicle joint the longest, not quite twice as long as wide; second and third each successively slightly shorter and slightly wider than first, and all longer than wide. Basal club joint slightly shorter than third funicle joint and slightly wider; second subequal in length to first; third plainly shorter. The antenna of this species is slightly different from that of *C. mexicensis* Girault. Figure 59 is drawn from a slightly shriveled specimen.

Fore wing about twice as long as wide, faintly and uniformly infuscated, closely and densely ciliated, ciliation of basal portion as shown in Figure 156. Submarginal vein slightly shorter than the marginal; postmarginal and stigmal as shown in Figure 94. Marginal fringe short. Submarginal vein furnished with eleven setae.

Scutellum a trifle wider than long (14:13) and about as long as mesoscutum. Abdomen (shriveled) slightly shorter than thorax, about one and one-third times as long as wide. Ovipositor not at all exserted. Dorsum of thorax rather conspicuously reticulated.

Mesoscutum furnished with numerous, rather small setae. Each axilla with two setae no stronger than those of the mesoscutum. Scutellum densely setose and with a pair of moderately long setae at apex and a preapical pair about one-half as long.

Middle tibial spur slightly shorter than basitarsus; basitarsus as long as following joints united. Paired spurs at apex of hind tibiae equal in length.

Measurements in mm.: Length 1.25. Pedicel 0.0528 long by 0.0504 wide. First funicle joint 0.1080 long by 0.0520 wide; second 0.08 long by 0.0568 wide; third 0.0696 long by 0.0608 wide. First club joint 0.06 long by 0.0618 wide; second 0.0520 long by 0.06 wide; third 0.0464 long by 0.0480 wide. Fore wings 1.0 long by 0.47 wide. Marginal vein 0.32 long; submarginal 0.20 long. Longest marginal fringe 0.0312.

Redescribed from one female (paratype), U.S.N.M. No. 20079. Morelos, Mexico, Koebele.

68. COCCOPHAGUS SAISSETIAE Gahan

Plate 9, Figure 66; Plate 11, Figure 125

Coccophagus saissetiae GAHAN, Proc. U. S. Nat. Mus., vol. 61, art. 24. 1922, p. 17.

A distinctive species of about the same general shape and size as *C. scutellaris* (Dalman) and *C. ishiii*, new species, from which it is readily distinguished by the different coloration of the legs and head. Fore wings faintly infuscated beneath the stigma.

Female.—General color black. Head mostly lemon yellow; occiput above black and ocellar triangle fuscous. According to the original description, the scutellum is apically bordered with yellow, this border comprising approximately one-fourth the length of the scutellum. In the paratype examined, this yellow is not evident although the derm is somewhat paler and differentiated toward the apex. Antennal scape mostly whitish, the flagellum brownish with darker sensoria. Legs mostly whitish, hind tibiae blackish except at apex.

Scape of usual shape, four times as long as wide. Pedicel slightly longer than wide and almost one-half as long as the first funicle joint. First funicle joint plainly longest, a trifle more than twice as long as wide; second and third successively shorter and very slightly wider so that the third is almost one and one-fourth times as long as wide. First club joint plainly shorter than third funicle joint, slightly wider than long and slightly wider than funicle; second club joint a trifle smaller than first; third club joint plainly the smallest, and plainly longer than wide. Funicle and club with rather abundant sensoria (fig. 66).

Fore wings faintly and indistinctly infuscated beneath stigmal vein, cilia moderately short and coarse, marginal fringe short. Wings slightly more than twice as long as wide. Marginal vein as long as the submarginal; postmarginal and stigmal as shown in Figure 125.

Scutellum slightly wider than long (13:12) and slightly shorter than the mesoscutum (12:14). Abdomen after shrinkage longer than wide (21:16) and shorter than the thorax (21:24). Ovipositor not at all exserted.

Mesoscutum furnished with numerous short, brownish setae. Each axilla with two setae similar to those of mesoscutum. Scutellum densely setose, the setae similar in size to those of mesoscutum, and with a pair of moderately long apical bristles and a preapical pair about one-half as long.

Dorsum of thorax rather conspicuously reticulated.

Tibial spur of middle legs a trifle shorter than basitarsus; basitarsus about as long as four following joints united. Paired spurs at apex of hind tibiae of equal length.

Measurements in mm.: Length 1.12. Scape 0.16 long by 0.04 wide. Pedicel 0.0544 long by 0.0472 wide. First funicle joint 0.12 long by 0.0528 wide; second 0.0880 long by 0.0544 wide; third 0.08 long by 0.0624 wide. First club joint 0.0576 long by 0.0656 wide; second 0.0520 long by 0.0592 wide; third 0.0480 long by 0.0392 wide. Fore wings 0.92 long by 0.43 wide. Marginal vein 0.28 long; submarginal 0.28 long. Longest marginal fringe 0.0232.

Male.—Head and body mostly black, becoming dark brown on sides and underparts of thorax and brownish on lower portion of face and cheeks. Antennal scape whitish, flagellum dark brown. Hind legs black, except for yellowish tarsi. Femora of fore and middle legs mostly blackish, pale at apices and the latter with an annulus at base. Fore and middle tibiae whitish with a faint suffusion of brownish or yellowish toward base. Tarsi of middle legs concolorous with apex of tibiae, those of the fore legs slightly brownish.

Length 0.7 mm.

Redescribed from one female and one male (paratypes) U.S.N.M. No. 24989. Reared from *Saissetia nigra* (Nietner), Ancon, Canal Zone, J. Zetek.

69. COCCOPHAGUS SCUTELLARIS (Dalman)

Plate 3, Figure 4; Plate 9, Figure 67; Plate 11 Figure 117; Plate 14 Figure 175

Entedon scutellaris DALMAN, Svensk. vet. Akad. Handl., vol. 46, 1825, p. 365.

Coccophagus scutellaris WESTWOOD, Philos. Mag., vol. 3, No. 32, 1833, p. 344; Intro. Mod. Class. Insects, Syn. of British genera, vol. 2, 1840, p. 73.

Myina semicircularis FÖRSTER, Beitrage Monog. Pterom., 1841, p. 44.

Encyrtus xanthostictus RATZEBURG, Ichneu. Forstins, vol. 3, 1852, p. 188.

Coccophagus lunulatus HOWARD, Insect Life, vol. 6, 1894, p. 232; U. S. Dept. Agr., Div. Ent., Tech. Ser. No. 1, 1895, pp. 37–38.—MASI, Boll Lab. Zool Gen. Agr., Portici, vol. 1, 1907, pp. 245–46.—HOWARD, Journ. Econ. Ent., vol. 4, 1916, p. 277.—QUAYLE, Calif. Agr. Expt. Sta. Bull. No. 223, 1911, p. 191.—MERCET, Trab. Mus. Cienc. Nat., Madrid, No. 10, 1912, pp. 240–41.—TIMBERLAKE, Journ. Econ. Ent., vol. 6, No. 3, 1913, pp. 299–300.—ESSIG,

Injurious and Beneficial Insects of Calif., ed. 2, 1915, p. 377.—COMPERE, Bull. So. Calif. Acad. Sci., vol. 22, part 4, 1924, pp. 113–16.—SMITH and COMPERE, Univ. Calif. Pub. Ent., vol. 4, No. 9, 1928, pp. 254–57.

Coccophagus australiensis GIRAULT, Insc. Inscit. Menst., vol. 5, 1917, p. 30.

In addition to the species listed in the above synonomy Mercet,[33] includes the following:

Coccophagus pulchellus WESTWOOD, Philos. Mag., vol. 3, 1833.
Aphelinus scutellaris WALKER, Monog. Chalcid., vol. 1, 1839.
Aphelinus lycimnia WALKER, Monog. Chalcid., vol. 1, 1839.
Aphelinus idaeus WALKER, Monog. Chalcid., vol. 1, 1839.
Coccophagus scutellaris WALKER, Entomologist, 1841.
Aphelinus insidiator var. *scutellaris* THOMPSON, Hymen. Scandin., vol 4, 1875.

Coccophagus pulchellus Westwood is a valid species and obviously an error was made in synonomyzing it. I do not have any first hand knowledge regarding the other species synonomyzed by Mercet.

The evidence strongly indicates that the cosmopolitan species now known by the name *C. lunulatus* Howard is identical with *C. scutellaris* (Dalman), the type species. The species can be definitely traced back to *C. xanthostictus* (Ratzeburg), described from Europe in 1852. In 1895, Howard wrote: "Mr. Ashmead possesses a pair of specimens from Germany labeled in Försters hand writing *Coccophagus xanthostictus*," I have had the privilege of examining this pair of specimens and so far as can be determined they are identical with the species previously known as *C. lunulatus* Howard. In a recent letter Mr. Gahan wrote: "When in Europe I saw the Ratzeburg collection and while I did not make complete notes on it I did see the types of *C. xanthostictus* (Ratzeburg) and recognized them at once as *C. lunulatus* Howard. While I had no specimens to compare, I feel certain of this and suggest that you change your manuscript name to include this synonomy." From this it is evident that the species existed in Europe as early as 1852. The evidence linking *C. xanthostictus* (Ratzeburg) with *C. scutellaris* (Dalman) is not so positive. Dalman's original description is as follows: "Niger, scutelli macula flava, antennis fuscis; pedibus fulvis, femoribus posticis nigris; alis immaculatis." *C. lunulatus* Howard is in agreement with the original description of Dalman and with the exception of *C. ishiii*, new species, it is the only known species to which the description can apply. The portion of the description which states that the legs are yellow with the posterior femora black eliminates all the species of the *C. lecanii* group and, since no other known species is in agreement with Dalman's description, the evidence seems to justify the recognition of this important species as *C. scutellaris* (Dalman).

[33] Marcet, Trab. Mus. Cienc. Nat. Madrid, No. 10, 1912, p. 251.

C. australiensis Girault is undoubtedly a synonym. In the collection of the Citrus Experiment Station is a specimen labeled "George Compere, No. 766, Perth, W. Australia, bred from *Lecanium hesperidum*." Girault's description was based on four females from Perth with George Compere's No. 766. The specimen in our collection is identical with the form known as *C. lunulatus* Howard and presumably Girault's types are the same.

C. scutellaris (Dalman) is a remarkably stable species subject to slight or no variation regardless of its habitat. Specimens in a series from one locality or specimens in a series from Europe, Africa, Australia, and America are remarkably uniform and except for *C. ishiii*, new species there are no closely related species to cause confusion. With the possible exception of Australia, *C. lecanii* (Fitch), or one of its allied forms, occurs in company with *C. scutellaris* (Dalman) throughout its known range and these two parasites have in common at least two hosts, notably *Coccus hesperidum* Linnaeus and *Saissetia oleae* (Bernard). It is the assumption that the world-wide distribution of the coccids was effected through the interchange of nursery stock and that the parasites were transported at the same time as inhabitants of the coccids and were subsequently influenced by the same environmental factors. On the basis of this reasoning, it is inconsistent to treat all the different geographical races of one form as a single species and to give specific rank to the various geographical variants of the other form. However, it is reliably established that more than one species is involved in the *C. lecanii* complex and at present there is no way to determine their genetical relationship and refer them to their ancestral stock.

Female.—Head and body black with the apical portion of scutellum more or less extensively yellow or orange. Occasionally imperfectly colored specimens are encountered, the portions usually black being brown or suffused with brownish. Extreme apex of scutellum not infrequently blotched with black. Legs yellow or orange yellow except middle and hind coxae and hind femora, which are black.

Scape of usual shape, slightly fusiform, about four times as long as wide. Pedicel a trifle more than one and one-half times as long as wide and about two-thirds as long as first funicle joint. First funicle joint longest, slightly more than twice as long as wide; second and third each successively slightly shorter and almost imperceptibly wider so that the third is slightly less than one and one-half times as long as wide. First club joint slightly the longest and widest; slightly longer than wide and not quite as long as the preceding funicle joint. Second and third club joints each progressively shorter and narrower (fig. 67).

Mandibles with two slightly developed ventral teeth and a broad dorsal margin as shown in Figure 175.

Fore wings faintly and uniformly infumated. Marginal vein plainly longer than submarginal vein; postmarginal produced about as far distad as stigmal; stigmal as shown in Figure 117. Wings finely and densely ciliated. Marginal fringe short.

Basitarsus of middle legs about as long as the three succeeding joints united; tibial spur plainly shorter than basitarsus. Paired spurs of hind tibiae slightly unequal.

Scutellum only a trifle wider than long and about as long as mesoscutum. In the dried, tag-mounted specimens, the abdomen appears about as long as the thorax and rounded at apex. Ovipositor not exserted.

Mesoscutum and scutellum clothed with dense, short, black setae; a pair of strong bristles at apex of scutellum. Eyes with numerous fine dark setae. Anterior margin of metanotum with two small setae on either side. Propodeum on either side with small, scattered setae. On the first and second tergites, the transverse rows of setae are not complete across the dorsum; on the following tergites, the hairs extend completely across the dorsum. Seventh tergite with many scattered setae.

Mesoscutum, scutellum, and axillae areolate reticulated on blackened portions. Metanotum on either side with one distinct wavy transverse carina. Propodeum on either side with a longitudinal carina mesad of the spiracles. Surface of most of the propodeum finely reticulated.

Measurements in mm. Length of average-sized specimen 1.1. Scape 0.1440 long by 0.0376 wide. Pedicel 0.0648 long by 0.0416 wide. First funicle joint 0.0992 long by 0.0464 wide; second 0.0896 long by 0.0512 wide; third 0.0760 long by 0.0520 wide. First club joint 0.0688 long by 0.0584 wide; second 0.0504 long by 0.0576 wide; third 0.0496 long by 0.0408 wide. Length of marginal vein 0.38; length of submarginal 0.28.

Male.—Similar to the female except that the scutellum is entirely black.

Redescribed from a large series of specimens including material from California; Italy; Cape Town, South Africa; Sydney, New South Wales; and Perth, Western Australia. This species attacks many different coccids including *Coccus hesperidum* (Linnaeus), *Coccus pseudomagnoliarum* (Kuwana), *Saissetia oleae* (Bernard), *Saisetia hemisphaerica* (Targioni), and *Pulvinaria mesembrianthemi* (Vallot).

70. COCCOPHAGUS ISHII, new species

Plate 9, Figure 68; Plate 11, Figure 92

This species is closely related to *C. scutellaris* (Dalman), from which it can be separated at a glance by the fore coxae, which are black in distinct contrast to the yellow fore coxae of *C. scutellaris*. Slight structural differences also separate the two species *C. ishii* having the antennae slightly thicker and the propodeum sculptured differently.

Female.—General color black, including head and antennae. Posterior two-thirds of scutellum lemon yellow Legs lemon yellow except all coxae which are black, and hind femora which are black except very narrowly at base. Tarsi of fore legs slightly brownish.

Antennae slightly thicker than those of *C. scutellaris*, but the differences are not pronounced. The slight differences in antennal proportions are best illustrated by the first funicle joint, which in this species is less than twice as long as wide, measuring 0.1136 mm. in length by 0.0632 mm. in width, while in *C. scutellaris* the first funicle joint is a trifle more than twice as long as wide, measuring 0.0992 mm. long by 0.0464 mm. wide. Pedicel about one and one-half times as long as wide and slightly more than one-half as long as first funicle joint. First funicle joint plainly longest, the following two successively slightly shorter and wider so that the third is about as wide as long (0.0768 mm. long by 0.0752 mm. wide). Club about twice as long as wide and broadly rounded at apex; all club joints wider than long (fig. 68). *C. scutellaris* has the first club joint a trifle longer than wide.

Mandibles very faintly and obscurely tridentate, almost emarginate except for the median tooth, which slightly projects and is broadly rounded.

Scutellum strongly convex, slightly wider than long (6:5) and about as long as mesoscutum, sutures closely fused. Abdomen about as long as thorax. Ovipositor not exserted.

Fore wings hyaline, closely and densely ciliated on disk, marginal fringe very short. Marginal vein plainly longer than submarginal, postmarginal very short as shown in Figure 92.

Mesoscutum, parapsides, axillae, and scutellum with network reticulation except on yellow portion of the scutellum which is not visibly sculptured. Propodeum between the longitudinal carinae mesad of spiracles with sculpture obsolete or very faint. In *C. scutellaris* the mesal portion of the propodeum is distinctly and more or less evenly reticulated.

Eyes clothed with numerous fine, pale hairs. Face, cheeks, and dorsum of head with numerous short, black setae. Mesoscutum with numerous short, black setae. Each parapsis with four or five short

setae. Each axilla with two short setae. Blackened portion of the scutellum with numerous short, black setae comparable to those of mesoscutum. Yellowed portions of scutellum with white or pale setae and at apex with a single pair of long black bristles. Anterior margin of the metanotum with two small setae on either side. Propodeum laterad of each spiracle with numerous short, black setae. First two abdominal tergites with small, black setae in transverse alignment on either side; on the succeeding tergites, the setae extend completely across dorsum. On the tergites beyond the third, the setae are more numerous and are not in transverse alignment.

Spur of middle tibia more than one-half as long as basitarsus; basitarsus of middle leg about as long as following joints combined. Paired spurs at apex of hind tibiae of about equal length.

Measurements in mm.: Length 1.4. Scape 0.1672 long by 0.0544 wide. Pedicel 0.0664 long by 0.0432 wide. First funicle joint 0.1136 long by 0.0632 wide; second 0.0896 long by 0.0680 wide; third 0.0768 long by 0.0752 wide. First club joint 0.0656 long by 0.0816 wide; second 0.0440 long by 0.0776 wide; third 0.04 long by 0.0552 wide.

Male.—Very similar to the female except for the usual sexual differences and the color of scutellum which is entirely black.

Type.—Cat. No. 42091, U.S.N.M.

Described from two females and one male (holotype, allotype, and paratype) obtained from T. I. Ishii with the following data: Females reared from *Eulecanium* sp. on *Euonymus*, Nagasaki, Japan; male reared from *Pulvinaria camelicola* Signoret, Kanajawa-ken, Japan.

71. COCCOPHAGUS SCUTATUS Howard

Plate 9, Figure 69; Plate 14, Figure 172

Coccophagus scutatus Howard, U. S. Dept, Agr. Bur. Ent. Tech. Bull. 1 1895, p. 38.

From other prevailing black species, *C. scutatus* differs conspicuously by the possession of a broad orange-colored band across the mesoscutum between the tegulae and embracing most of the axillae. Scutellum entirely black.

Female.—General color black. Posterior one-third of mesoscutum and axillae orange-colored, axillae sometimes yellow with a blackish median blotch. Portions of sclerites in proximity to bases of fore wings occasionally pale. Face and cheeks dark brown to ferruginous. Antennae brown. Color of legs variable. Fore legs usually with coxae paler than succeeding joints which are more or less brownish. Middle legs with coxae brown to blackish, trochanters and basal two-thirds of femora concolorous, latter pale brown on apical portion; tibiae light brown, concolorous with apices of femora. Hind legs

with coxae, trochanters, and femora pale or faintly brownish to whitish, sometimes touched with fuscous. Hind tibiae blackish or dark brown on basal half, apical portion brownish. Tarsi of all legs light brown, apices tipped with dusky.

Antennal scape of usual shape, slightly fusiform, and slightly longer than club. Pedicel about one and one-third times as long as wide and about three-fifths as long as first funicle joint. Funicle joints successively slightly shorter and slightly wider distad. First funicle joint a trifle more than twice as long as wide; third funicle joint about one and one-half times as long as wide. Club as long as two preceding funicle joints united and about one and one-third times as wide as third funicle joint (fig. 69).

Mandibles with one small but well defined ventral tooth and a broad dorsal truncation. One of the ventral peg-shaped spines unusually stout as shown in Figure 172.

Fore wings faintly infumated. Submarginal vein plainly longer than marginal, postmarginal produced as far distad as stigmal. Cilia on disk rather coarse beneath veins, becoming finer and denser toward apex of wing. Marginal fringe short.

Basitarsus of middle legs about as long as following joints united; tibial spur about two-thirds as long as basitarsus. Paired tibial spurs of hind legs slightly unequal.

Scutellum (in tag mount) about as long as wide and as long as mesoscutum. Abdomen slightly longer than wide (6:5) and as long as thorax, broadly rounded at apex. In balsam-mounted specimens, the abdomen appears almost rotund; ovipositor short, arising near middle and not at all exserted.

Mesoscutum and scutellum densely setose, scutellum also with a pair of strong apical bristles. Each parapsis with six setae. Each axilla with two setae. Eyes with pubescence extremely fine and pale, almost imperceptible. First three abdominal tergites with black hairs on either side, following tergites with a complete band of hairs across dorsum.

Blackened portion of mesoscutum, axillae, and scutellum strongly reticulated. The reticulations on sides of axillae only slightly longitudinally lengthened, the difference hardly appreciable in tag-mounted specimens.

Measurements in mm.: Scape 0.2256 long by 0.0392 wide. Pedicel 0.06 long by 0.0448 wide. First funicle joint 0.1080 long by 0.0504 wide; second 0.1024 long by 0.0560 wide; third 0.0880 long by 0.0568 wide. First club joint 0.0880 long by 0.0752 wide; second 0.0512 long by 0.0712 wide; third 0.0464 long by 0.0504 wide. Marginal vein 0.34 long; submarginal 0.42 long.

Redescribed from 25 females reared from a *Kermes* on oaks collected at different times and from various localities in southern California.

72. COCCOPHAGUS IMMACULATUS Howard

Plate 9, Figure 70; Plate 11, Figure 107; Plate 13, Figure 158

Coccophagus immaculatus Howard, U. S. Dept. Agr. Rept. Ent. for 1880, 1881, p. 358; U. S. Dept. Agri. Div. Ent. Tech. Series, No. 1, 1895, p. 35.—Mercet, Trab. Mus. Cienc. Nat. No. 10, 1912, p. 236.

This species is of moderate size and slender stature, with hyaline wings and densely setose scutellum. The other prevailingly black or dark-brown species with a setose scutellum are usually of stouter stature than is this species. The tag-mounted specimen is badly shriveled.

Female.—General color dark brownish black with the propodeum yellowish. Originally described as black in color but the paratype examined is distinctly suffused with brownish, especially on the mesopleura. The propodeum (metanotum of Howard) originally described as lemon yellow, now appears slightly marked with brownish across the meson. Flagellum of antenna brownish yellow, sensoria blackish. Scape blackish. Cheeks and face dark brown. Fore coxae brown; middle and hind coxae pallid white. All trochanters pale, those of fore legs somewhat yellowish, the others pallid white. Femora of fore legs brownish, slightly pale at ends. Basal third of middle femora pallid white, extreme apex pale, intermediate portion brownish. Basal third of hind femora pallid white, remainder brown. Fore tibiae slightly brownish; middle and hind tibiae distinctly yellow. All tarsi yellowish, those of middle and hind legs paler than those of fore legs. All apical tarsal joints slightly dusky.

Antennal scape of usual shape, slender and slightly subfusiformly cylindrical. Pedicel plainly longer than wide and much shorter than first funicle joint. First funicle joint longest, a trifle more than twice as long as wide; second and third each successively shorter and a trifle wider, all plainly longer than wide. First club joint almost as long as third funicle joint and plainly wider, a trifle wider than long; second the shortest, wider than long; third a trifle longer than second, and not quite as wide as long. The short second club joint may be an abnormality. To the eye the club joints appear subequal in length (fig. 70). In the figure, the dotted outline of the pedicel and scape was drawn by eye from the parts remaining on the tag mount.

Fore wings hyaline, with basal cilia arranged as shown in Figure 158. Submarginal vein slightly longer than the marginal, stigmal and postmarginal shown in Figure 107. Marginal fringe short, 0.0248 mm.

Scutellum about as long as wide (10:11) and about as long as mesoscutum. Abdomen distorted in the specimen examined but presumably about as long as thorax.

According to the description in the Revision of the Aphelininae, the punctured scutellum of this species is unique. The scutellum is furnished with setigerous punctures and is reticulated. Mesoscutum with the setigerous punctures in more or less regular, longitudinal alignment and a trifle coarse, especially those aligned along parapsidal and scutellar sutures, but in this respect not unlike certain other species. Disk of the scutellum about as densely setose as mesoscutum, its apical third or so without the small setae but with a rather weak pair of apical bristles and a smaller preapical pair. Setae appear somewhat pale in certain lights and bristles distinctly so.

Measurements in mm.: Length 1.05. First funicle joint 0.0840 long by 0.0376 wide; second 0.0704 long by 0.04 wide; third 0.0648 long by 0.0464 wide. First club joint 0.0624 long by 0.0640 wide; second 0.0456 long by 0.0608 wide; third 0.0536 long by 0.0440 wide. Fore wings 0.94 long by 0.43 wide. Marginal vein 0.24 long; submarginal 0.28 long. Longest marginal fringe 0.0248.

Male.—Differs from the female principally in having propodeum and all coxae blackish.

Length 0.75 mm.

Redescribed from one female and one male (paratypes) U.S.N.M. No. 2600. Parasitic on *Eriococcus azaleae*, Washington, D. C. Female collected January 22, 1881, and male collected February 5, 1881.

73. COCCOPHAGUS PULCHELLUS Westwood

Plate 9, Figure 71; Plate 11, Figure 133; Plate 13, Figure 155

Coccophagus pulchellus WESTWOOD, Philos. Mag., vol. 3, No. 17, 1833, p. 344.

In a series of specimens borrowed from the United States National Museum are two females on a single tag labeled in what is believed to be Ashmead's handwriting, "*Coccophagus pulchellus* Westwood." The pin bears the additional data, "*P. Marchal*, France, No. 2." This is a distinct species that agrees very well with Westwood's original description. It is a medium-sized species liberally marked with yellow, wings hyaline, scutellum setose, abdomen rotund and hardly longer than wide.

Female.—Pronotum, mesoscutum, and abdomen completely black; median portion of the propodeum black; remainder of head and body mostly pure pale yellow. Axillae with a brownish suffusion. Prepectus brownish. Antennae yellow, the numerous sensoria of the flagellum blackish. Legs pure pale yellow except the apical tarsal joints of all legs which are slightly dusky, and the tarsi of the fore legs which are slightly brownish. All hairs and bristles of the legs pale yellow. Mandibles slightly brownish. Eyes dark chocolate.

Antennal scape apparently of usual size and shape. Pedicel somewhat longer than wide and plainly much shorter than the first funicle joint. First funicle joint the longest, approximately twice as long as wide; second and third progressively shorter and slightly wider so that the third is only slightly longer than wide. First club joint not quite as long as the preceding funicle joint and slightly wider (fig. 71). The figure of the antenna is in part a hypothetical reconstruction based on a shriveled specimen.

Posterior ocelli about twice their own diameter from the eye margins and probably a trifle less than once their own diameter from the occipital margin.

Mandibles with two ventral teeth and a truncation.

Cheeks with a faint suture from the base of the eyes to the mouth. Fronto-facial suture deeply lined, distinct; a well impressed median longitudinal suture extending to the anterior ocellus. Face and cheeks without a distinct sculpture. Frontovertex faintly punctulate reticulate. Mesoscutum finely areolate reticulate, the reticulations on the scutellum fainter.

Face, cheeks, and eyes with extremely fine, short, pale, hardly discernible hairs. Frontovertex with moderately coarse, short, black setae which are rather conspicuous because of the contrast in colors. Mesoscutum with black setae. Scutellum except about the apical fifth nearly as densely setose as the mesoscutum, the apex furnished with a pair of moderately stout bristles. Each axilla with two rather weak setae or bristles, these somewhat stronger than the strongest setae of the mesoscutum. Each parapsis with about four setae of the same size as those on the axillae. Sides of propodeum with fine white hairs.

Scutellum wider than long (5:4) and slightly shorter than the mesoscutum. Abdomen, in tag mount, rotund, only a trifle longer than wide and plainly much shorter than the thorax. Ovipositor not exserted.

Fore wings clear hyaline, slightly more than twice as long as wide. Marginal vein rather thick, slightly shorter than the submarginal; postmarginal well developed, produced farther distad than the stigmal as shown in Figure 133. Cilia on the basal portions of the wing arranged in a pattern as shown in Figure 155. Cilia small, those beyond the figured basal portion smaller and very dense. Marginal fringe very short.

Measurements in mm.: Length 1.25. Scape 0.1880 long. Pedicel 0.0584 long. First funicle joint 0.0920 long; second 0.08 long; third 0.0712 long. First club joint 0.0512 long; second 0.0440 long; third 0.0440 long. Fore wings 1.28 long by 0.60 wide. Marginal vein 0.34 long; submarginal 0.38 long. Longest marginal cilia 0.0280.

Redescribed from two specimens as noted above.

74. COCCOPHAGUS HOWARDI Masi

Plate 9, Figure 72; Plate 11, Figure 115

Coccophagus howardi Masi, Boll. Lab. Zool. Gen. Agr. Portici, vol. 1, 1907, pp. 243–45, figs. 6–7.—Martelli, Boll. Lab. Zool. Gen. Agr. Portici, vol. 2, 1908, pp. 238–40, fig. 8.—Mercet, Trab. Mus. Cienc. Nat. No. 10, 1912, pp. 232–36, fig. 56.—Silvestri, Boll. Lab. Zool. Gen. Agr. Portici, vol. 13, 1919, pp. 91–92.

Francis Walker [34] described what he supposed to be *Entedon scutellaris* Dalman and placed it in the genus *Aphelinus*. Mercet refers this description doubtfully to synonymy with *Coccophagus howardi* Masi and Silvestri confirms this synonymy. The latter author also lists *Aphelinus idaeus* Walker [35] and *Myina scutellaris* Foerster [36] together with the new name *Aphelinus foersteri* given the latter by Dalla Torre [37] as doubtful synonyms of *C. howardi*. The writer is unable to confirm or deny this synonymy.

Coccophagus howardi Masi is a rather distinctive species and should be easily recognized providing the coloration is not too variable. Masi, in his description, notes that the color is variable but does not mention the fact that one cotype has the scutellum entirely yellow. Masi's well known figure of the adult shows the scutellum mostly blackish with only the apex yellow. It is probable that the single female studied by me represents an extreme variant and that the average specimen can best be recognized by Masi's excellent description.

Female.—Pronotum, mesoscutum, and axillae black. Parapsides and tegulae suffused with brownish. Scutellum completely orange yellow. Metanotum, including the small, median piece, slightly dingy lemon yellow. Propodeum mostly lemon yellow, on the meson between the longitudinal carinae suffused with fuscous. Abdomen mostly shining black. Frontovertex orange yellow with the ocellar triangle blackish. Face and cheeks blackish to dark brown. Antennae including the scape and pedicel yellow. Sensoria brownish.

In the specimen seen by me, the sensoria are more numerous than are shown in Masi's figure; as an example the basal club joint, in lateral view, shows six linear sensoria. A small spot on body at the base of the fore wing beneath the tegulae brownish orange. Mesopleura mostly blackish with some brownish or orange suffusions. Mesosternum yellow. Prepectus including the ventral part blackish. Except for the coxae which are black (the fore legs are missing but the missing parts are presumably concolorous with the middle and hind legs) the legs are entirely pale lemon yellow.

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[34] Monog. Chalcid., vol. 1, 1839, p. 6.
[35] Idem, p. 12.
[36] Beitr. Monog. Pterom., 1841, p. 441.
[37] Cat. Hym., vol. 5, 1898, p. 221.

Pedicel of antenna plainly shorter than the first funicle joint and about one and one-half times as long as wide. First funicle joint the longest, almost twice as long as wide; second and third each slightly shorter and slightly wider than the preceding. Third funicle joint plainly longer than wide, about one and one-half times as long as wide. Basal club joint about as long as the preceding funicle joint and wider so that the club joint appears wider than long. First club joint about as long as the second and narrowed distally; third club joint the smallest (fig. 72).

Scutellum slightly wider than long (12:10) and almost as long as the mesoscutum (10:11). After shrinkage the abdomen is comparatively small and of distinctive shape. It is plainly much shorter than the thorax, about as wide as long, strongly depressed, and the sides widen from the base to shortly before the apex, where the cercal plates are located. The apex is widely rounded. Ovipositor not at all exserted.

Mesoscutum furnished with numerous small setae which are paler than the black derm. Parapsides and axillae apparently with the usual number of setae, that is, four and two on each, respectively. Scutellum with numerous fine, pale setae and a pair of bristles at the apex.

Fore wings hyaline, of usual shape, finely and densely ciliated. The hairless area parallel to the posterior margin of the wing at the base joins with a short, diagonal, hairless streak extending upward and outward. Marginal vein and submarginal subequal; postmarginal produced about as far distad as the apex of the stigmal as shown in Figure 115. Wing veins distinctly yellow.

Measurements in mm.: Length 1.0. Scape 0.16 long by 0.0360 wide. Pedicel 0.0536 long by 0.0368 wide. First funicle joint 0.0720 long by 0.0376 wide; second 0.0616 long by 0.6384 wide; third 0.0576 long by 0.0416 wide. First club joint 0.0464 long by 0.0632 wide; second 0.0424 long by 0.0560 wide; third 0.0368 long by 0.0432 wide. Fore wings 0.84 long by 0.46 wide. Marginal vein 0.26 long; submarginal 0.32 long. Longest marginal cilia 0.0224.

Male.—Entire thorax mostly black, only the parapsides, tegulae, and mesopleura faintly tinged with some brownish. Head mostly lemon yellow, the ocellar triangle and the occiput above the insertion of the neck blackish. Legs entirely pale lemon yellow. Except for the genital characters and a differently shaped abdomen, similar to the female.

Length 0.97 mm.

Redescribed from one female and one male (cotypes), U.S.N.M. No. 40214. The specimen labeled as follows: "On *Philippia* [*Filippia*] *oleae*. Catanzaro, Italy. Masi, Coll."

75. COCCOPHAGUS NIGROPLEURUM Girault

Coccophagus nigropleurum GIRAULT, Descriptiones Stellarum Novarum. Wash., D. C. (Published by author) 1917, p. 1.

Redescribed from a single female paratype that has lost the head. If the coloration of this species is variable, it may be difficult to recognize from this redescription as well as from the original description. An orange yellow and black species with hyaline wings and with the scutellum less densely setose than is the mesoscutum.

Female.—Orange yellow with the following parts black: center of occiput; anterior margin of the mesoscutum; a spot on the anterior mesal margin of each parapsis; the slender wedge-shaped posterior portion of each parapsis lying between the axillae and mesoscutum; metanotum except the median piece; a slight infusion on the propodeum; abdomen, except the basal angles and behind the cercal plates where it fades to brownish orange; and the pleurites except near the sutures. Sternites mostly yellowish. Middle tibiae with the median part slightly suffused with dusky. Hind tibia slightly dusky toward the base. Remainder of the legs pallid yellow to faintly brownish yellow. According to Girault, antennal scape yellow, the rest of the antenna black.

First funicle joint originally described as twice as long as wide.

Scutellum wider than long (12:9) and plainly shorter than the mesoscutum (9:11). Abdomen slightly shorter than the thorax, longer than wide (10:7). Ovipositor not exserted.

Mesoscutum with numerous black setae in more or less regular longitudinal alignment. The disk of the scutellum about as densely setose as the mesoscutum but bare on the sides and toward apex, the apex with a pair of black bristles. Each axilla with two setae and each parapsis with four similar setae.

Fore wings hyaline, densely and closely ciliated. Marginal fringe moderately short. Submarginal vein about equal in length to the marginal.

Redescribed from one female (paratype) U.S.N.M. No. 20076 reared from *Tachardia decorella*, collected by C. C. Gowdey at Kampala, Uganda, Africa, October 4, 1915.

76. COCCOPHAGUS SILVESTRII, new species

Plate 9, Figure 73; Plate 11, Figure 129

This striking species is easily recognized by the coloration and unusually long apical scutellar bristles.

Female.—Lemon yellow marked with dark brown or fuscous as follows: exposed part of pronotum, anterior half of mesoscutum arcuately, sides of metanotum, center of propodeum, and entire abdomen. In certain lights the dark coloration, especially on the mesoscutum, has metallic bluish reflections. Legs entirely pale yellow.

Pedicel about one and one-half times as long as wide and about one-half as long as the first funicle joint. First funicle joint plainly the longest, twice as long as wide; following funicle joints successively shorter and almost imperceptibly wider so that the third joint is hardly longer than wide. Club about as long as the first and second funicle joints combined; basal club joint subequal to the third funicle joint. Antenna with details of sensoria as shown in Figure 73.

Mandibles with a slightly developed apical tooth and a broad truncation. The mandibular peg-shaped spines large and conspicuous.

Fore wings hyaline or very faintly uniformly smoky; cilia of disk moderately dense. Marginal vein plainly longer than the submarginal; stigmal as shown in Figure 129. Exact length of postmarginal vein not ascertainable in the balsam-mounted specimen available for study.

Scutellum slightly wider than long (5:4) and as long as the mesoscutum. Abdomen about as long and as wide as the thorax; in dried tag-mounted specimens truncate at apex. Ovipositor arises near the base of abdomen.

Frontovertex with strong, brown setae which are very conspicuous in contrast to the yellow parts. Face and checks with fine, pale setae. Dorsum of thorax strongly setose. Each axilla with two setae. Scutellum about as densely setose as the mesoscutum and at apex furnished with an unusually long pair of bristles; two pairs of preapical lateral bristles are not much larger than the discal setae. Second and third tergites with a broadly interrupted row of setae. Fourth, fifth, and sixth tergites with a row of setae completely across the dorsum. Seventh tergite with scattered setae. Knees of middle legs with conspicuous large brown setae. Tibial spur slightly shorter than the basitarsus.

Length 1.2 mm.

Type.—Cat. No. 42104, U.S.N.M.

Described from 4 females (holotype and paratypes) reared by Dr. F. Silvestri from a *Lecanium* sp., Foochow, China, July 1, 1924.

SPECIES OF COCCOPHAGUS UNRECOGNIZED

Some species, mostly European, remain unrecognized. A few of the older European descriptions are not available to me but Spanish translations of the originals were consulted in the work of Mercet.[38] Certain species are known to me only by Mercet's Spanish translations and since very few European specimens are available for study, I am unable to clarify the confused European synonomy.

[38] Mercet, Trab. Mus. Cienc. Nat., No. 10, Madrid, 1912, pp. 221–252.

C. pulchellus Westwood is recognized as valid in this paper, although previously synonymized, and it is suspected that certain other species now in synonomy may eventually be rediscovered. Since the European authors are not in agreement regarding the synonomy of some of the older, inadequately, described species and because of my uncertainty, references to only the original descriptions are given in the following pages.

COCCOPHAGUS INSIDIATOR (Dalman)

Entedon insidiator DALMAN, Svensk. Vet. Akad. Handl., vol. 46, 1825.

Without much doubt *C. lecanii* (Fitch) or one of its closely related forms will be eventually referred to this species. For a list of the species that have been referred to *C. insidiator* (Dalman), the work of Mercet should be consulted.

COCCOPHAGUS OBSCURUS Westwood

Coccophagus obscurus WESTWOOD, London and Edin. Philos. Mag., No. 3, vol. 17, 1833, p. 344.

This species now stands as a synonym of *C. insidiator* (Dalman) but I suspect an error, for the descriptions are not in agreement nor have I seen any specimens that agree with Westwood's original description.

COCCOPHAGUS INARON (Walker)

Aphelinus inaron WALKER, Monog. Chalcid., vol. 1, 1839.

COCCOPHAGUS MOERIS (Walker)

Aphelinus moeris WALKER, Monog. Chalcid., vol. 1, 1839.

COCCOPHAGUS ARGIOPE (Walker)

Aphelinus argiope WALKER, Monog. Chalcid., vol. 1, 1839.

COCCOPHAGUS FÖRSTERI (Dalla Torre)

Myina scutellaris FÖRSTER, Beitr. Monog. Pterom., 1841, p. 441 (not *scutellaris* Dalman).

Aphelinus försteri DALLA TORRE, Cat. Hym., vol. 5, 1898, p. 221.

This species is doubtfully placed in synonymy with *C. howardi* Masi by Silvestri.[39]

COCCOPHAGUS NOTATUS (Ratzeburg)

Coccobius notatus RATZEBURG, Ichn. Forst. Inst., 1852.
Coccophagus notatus HOWARD, Div. Ent., U. S. D. A. Tech. Ser. No. 1, 1895, p. 11.

Dr. L. O. Howard is authority for the statement that this species is a *Coccophagus*.[40] According to Mercet's translation of the original description, this species is not unlike *C. lecanii* (Fitch) or one of its allies.

[39] Boll. Lab. Zool. Gen. Agr. R. Scuola Sup. Agr. Portici, vol. 13, 1919, p. 91.
[40] U. S. Dept. Agri., Div. Ent., Tech. Bull. 1, 1895, p. 11.

COCCOPHAGUS NIGRIFRONS Wollaston

Coccophagus nigrifrons WOLLASTON, Ann. and Mag. Nat. Hist., vol. 3, 1858, p. 27.

From the island of Madeira, in 1858, Wollaston described a species in the following words: "C. foem. niger; antennis piceis, clavatis, corporis dimidio brevioribus; scutello flavo apice nigro; abdomine nigro-aeneo; femoribus nigris, tarsis anticis fulvis; alis hyalinis.—Long. corp. 1/3, alar 3/4 lin."

In a recent publication Mercet questionably refers a species, reared by Doctor Paoli from *Coccus hesperidum* Linnaeus, collected on the Island of Madeira, to *C. nigrifrons* Wollaston.[41] Mercet says that the specimens obtained by Doctor Paoli are not in entire agreement with Wollaston's description, since they have the legs yellow except for the middle and hind coxae and hind femora which are blackish. He also said that the specimens collected by Paoli have the scutellum setose and the species is related to *C. scutellaris* (Dalman). On the basis of the published evidence, it appears that the specimens studied by Mercet are referable to *C. scutellaris* (Dalman) and are not the same as the species described by Wollaston. Since *C. scutellaris* (Dalman) and *C. lecanii* (Fitch), or one of its forms, usually coexist and share *Coccus hesperidum* Linnaeus as a host, it seems likely that Wollaston studied *C. lecanii*, or one of its closely allied forms, for his description states that the femora are black and the logical assumption is that the reference is to all the femora and not to the hind femora as interpreted by Mercet.

COCCOPHAGUS PURPUREUS Ashmead

Coccophagus purpureus ASHMEAD, Trans. Amer. Ent. Soc., vol. 13, 1886, p. 132.—HOWARD, Div. Ent. U. S. D. A. Tech. Ser. No. 1, 1895, p. 36.

COCCOPHAGUS NUBECULUS Brèthes

Coccophagus nubeculus BRÈTHES, Ann. Nac. Mus. Buenos Aires, vol. 24, 1913, p. 97.

COCCOPHAGUS LUCANI Girault

Coccophagus lucani GIRAULT, Insec. Insc. Menst., vol. 10, 1922, p. 108.

COCCOPHAGUS POEI Girault

Coccophagus poei GIRAULT, Mem. Queensland Mus., vol. 4, 1915, p. 55.

COCCOPHAGUS FUNERALIS Girault

Plate 12, Figure 146; Plate 13, Figure 152

Coccophagus funeralis GIRAULT, Mem. Queensland Mus., vol. 4, 1915, p. 185.

In the original description, it is said that the type specimen is a female. I have had the privilege of examining the specimen and believe that it is a male.

[41] Mercet, Eos, Rev. Esp. Ent., vol. 3, No. 4, 1927, pp. 494–496.

COCCOPHAGUS PANTHERINUS Giraud

This name was included in a list of parasitic hymenoptera and their hosts published by Giraud [42] and was again mentioned by Howard [43] in connection with a list of parasites of *Kermes*. So far as known, the species has never been described and is apparently a *nomen nudum*.

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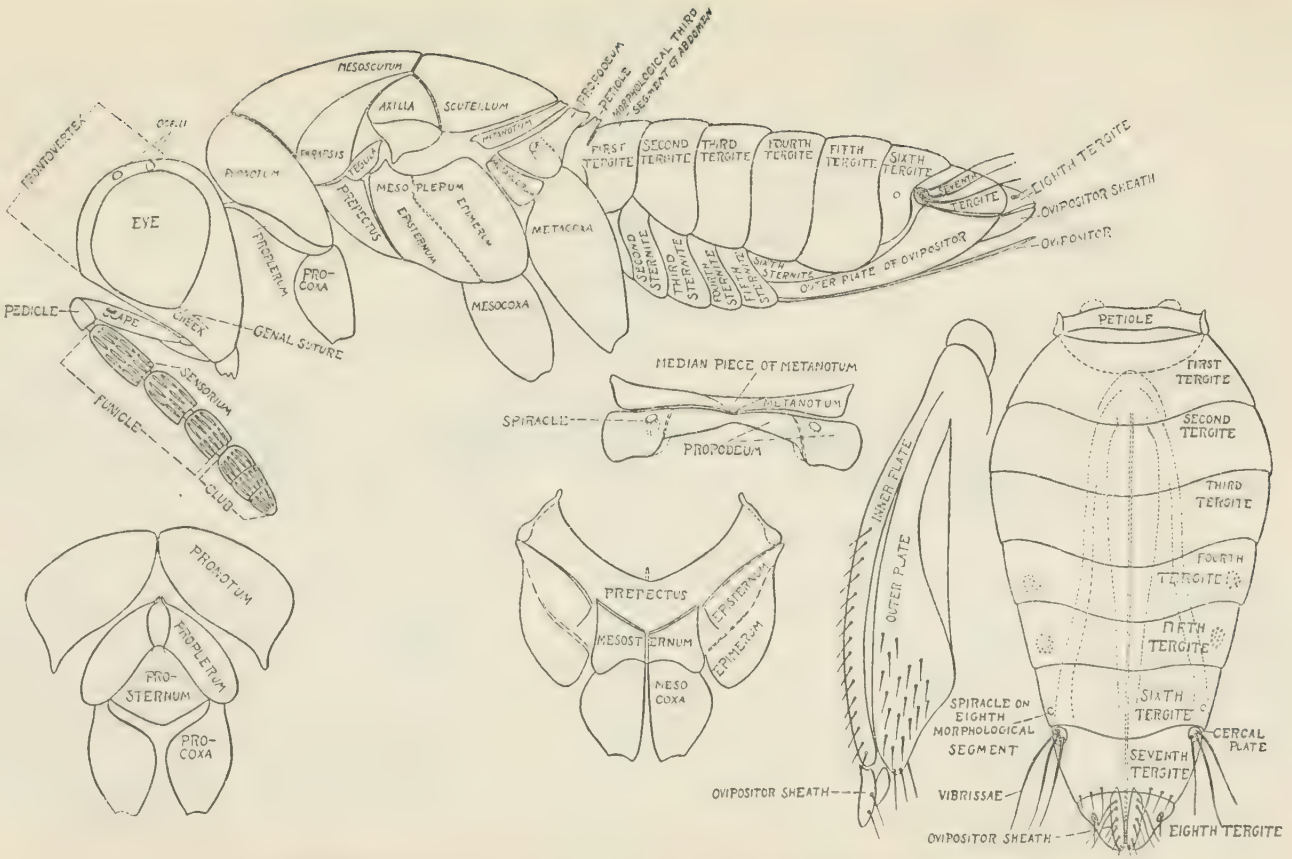
[42] Ann. Soc. Ent. Fr., 1877, p. 419.
[43] Ent. News, vol. 30, 1919, p. 258.

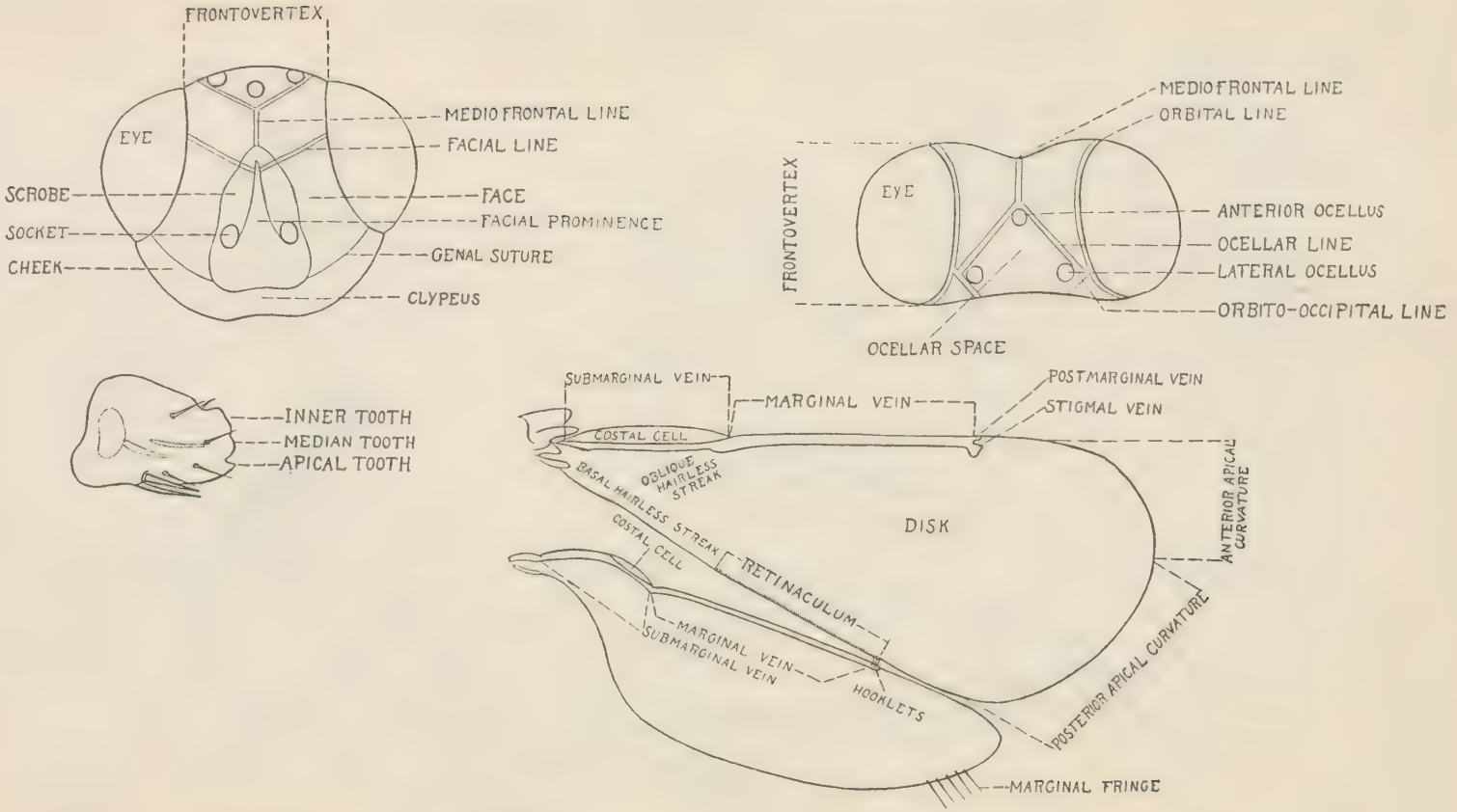
EXPLANATION OF PLATES

Plate 1

Figure 1. *Coccophagus malthusi* Girault; female with parts named.



COCCOPHAGUS MALTHUSI GIRAULT; FEMALE WITH PARTS NAMED



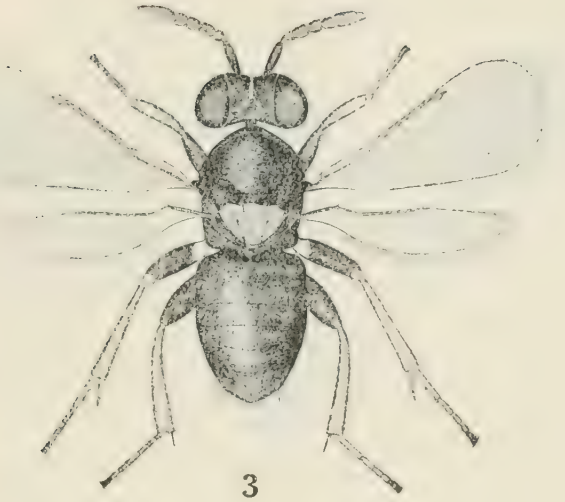
COCCOPHAGUS MALTHUSI GIRAULT; FEMALE WITH PARTS NAMED

PLATE 2

FIGURE 2. *Coccophagus malthusi* Girault; female with parts named.

PLATE 3

FIGURE 3. *Coccophagus cowperi* Girault; female.
4. *Coccophagus scutellaris* (Dalman); female.



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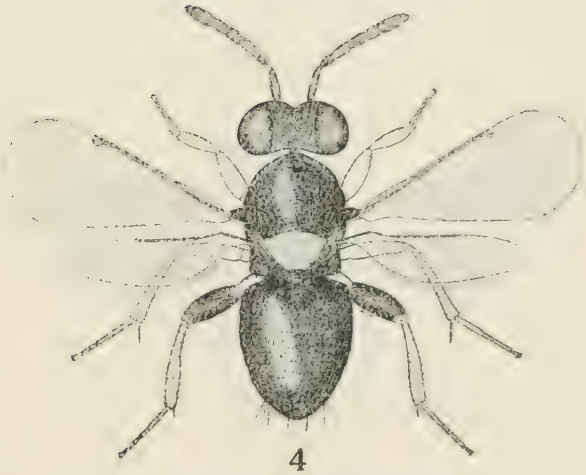
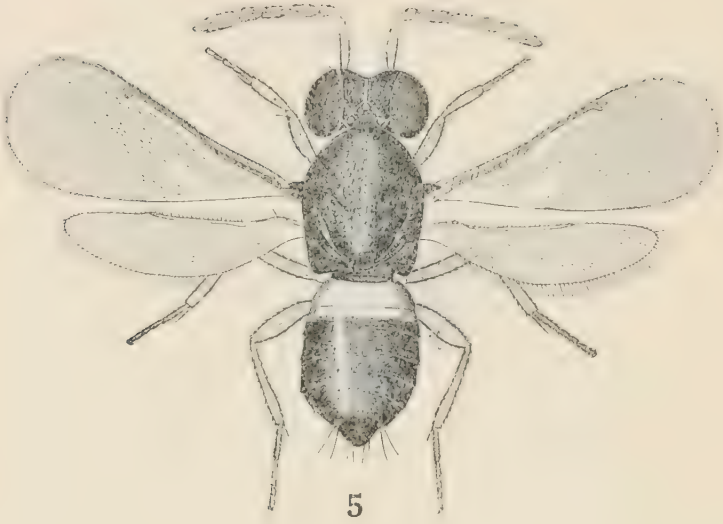


4

SPECIES OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 118



5

6

SPECIES OF COCCOPHAGUS

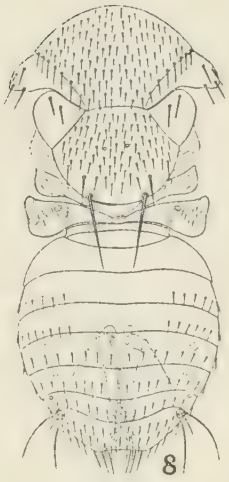
FOR EXPLANATION OF PLATE SEE PAGE 119

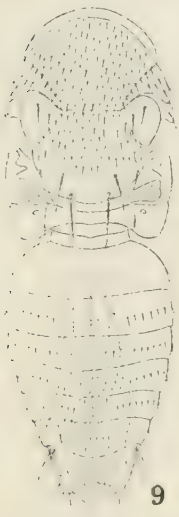
PLATE 4

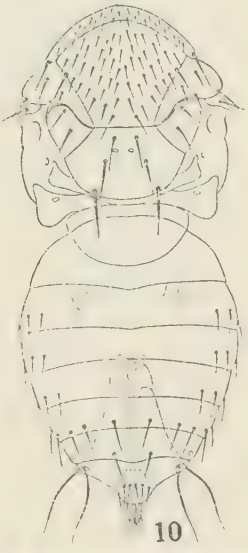
FIGURE 5. *Coccophagus gurneyi* Compere; female.
6. *Coccophagus spectabilis*, new species; female.

Plate 5

Figure 7. *Coccophagus isipingoensis* new species; female.
8. *Coccophagus robustus*, new species; female.
9. *Coccophagus nigritus*, new species; female.
10. *Coccophagus margaritatus*, new species; female.

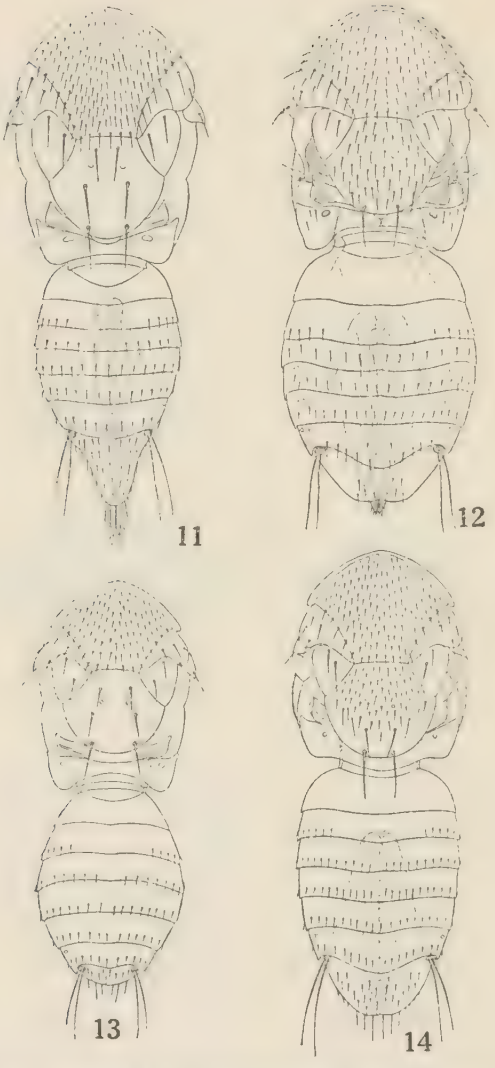






DETAILS OF THE THORAX AND ABDOMEN OF SPECIES OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 120



DETAILS OF THE THORAX AND ABDOMEN OF SPECIES OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 121

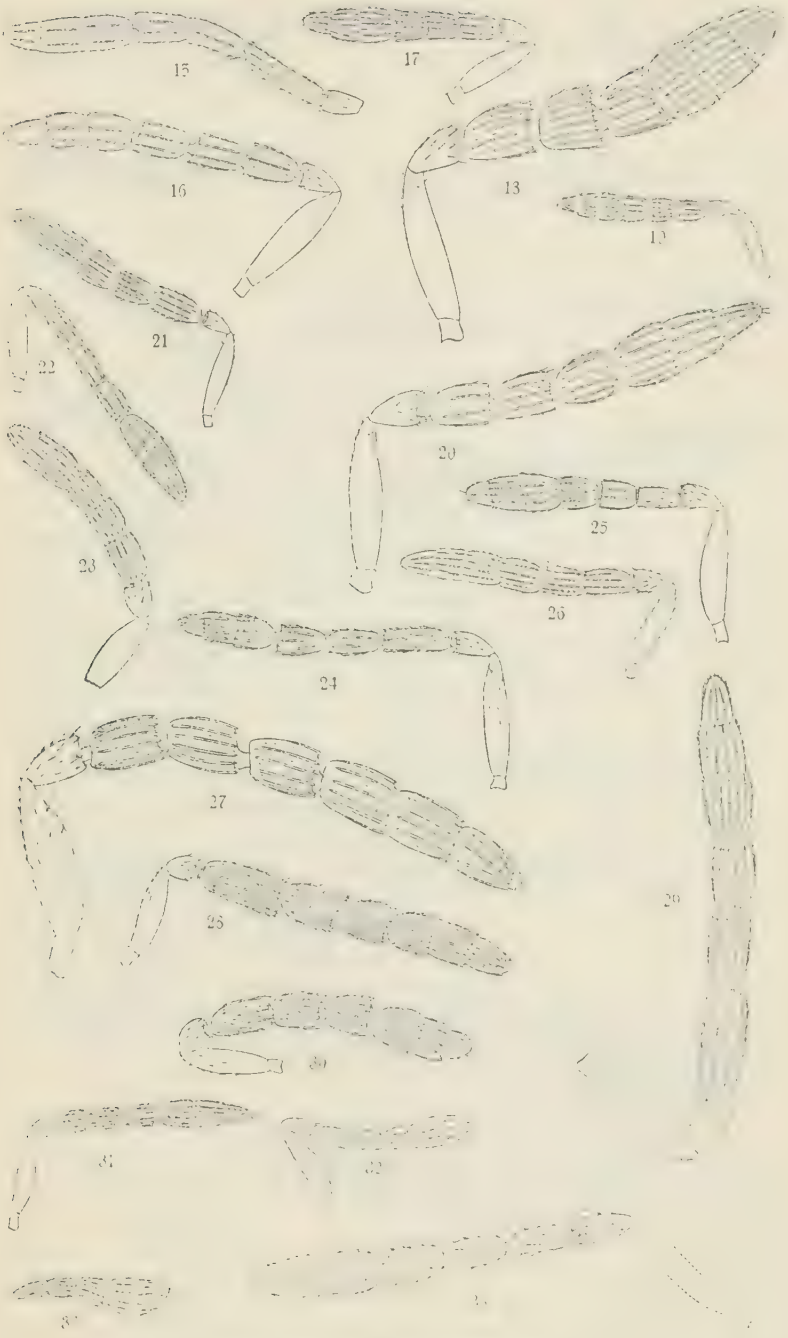
PLATE 6

FIGURE 11. *Coccophagus flaviceps*, new species; female.
12. *Coccophagus nubes* Compere; female.
13. *Coccophagus rusti* Compere; female.
14. *Coccophagus yoshidae* Nakayama; female.

PLATE 7

Coccophagus antennae, females

FIGURE 15. *Coccophagus redini* Girault.
16. *Coccophagus lepidus*, new species.
17. *Coccophagus flavifrons* Howard.
18. *Coccophagus anthracinus* Compere.
19. *Coccophagus timberlakei*, new species.
20. *Coccophagus atratus* Compere.
21. *Coccophagus rusti* Compere.
22. *Coccophagus flavescens* Howard.
23. *Coccophagus perhispidis* Girault.
24. *Coccophagus gurneyi* Compere.
25. *Coccophagus tarongaensis*, new species.
26. *Coccophagus signus* Girault.
27. *Coccophagus mariformis*, new species.
28. *Coccophagus flaviceps*, new species,
29. *Coccophagus tschirchii* Mahdihassan.
30. *Coccophagus gregarius*, new species.
31. *Coccophagus javensis* Girault.
32. *Coccophagus triguttatus* Girault.
33. *Coccophagus specialis*, new species
34. *Coccophagus triangulatinotus* Girault.



ANTENNAE OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 122

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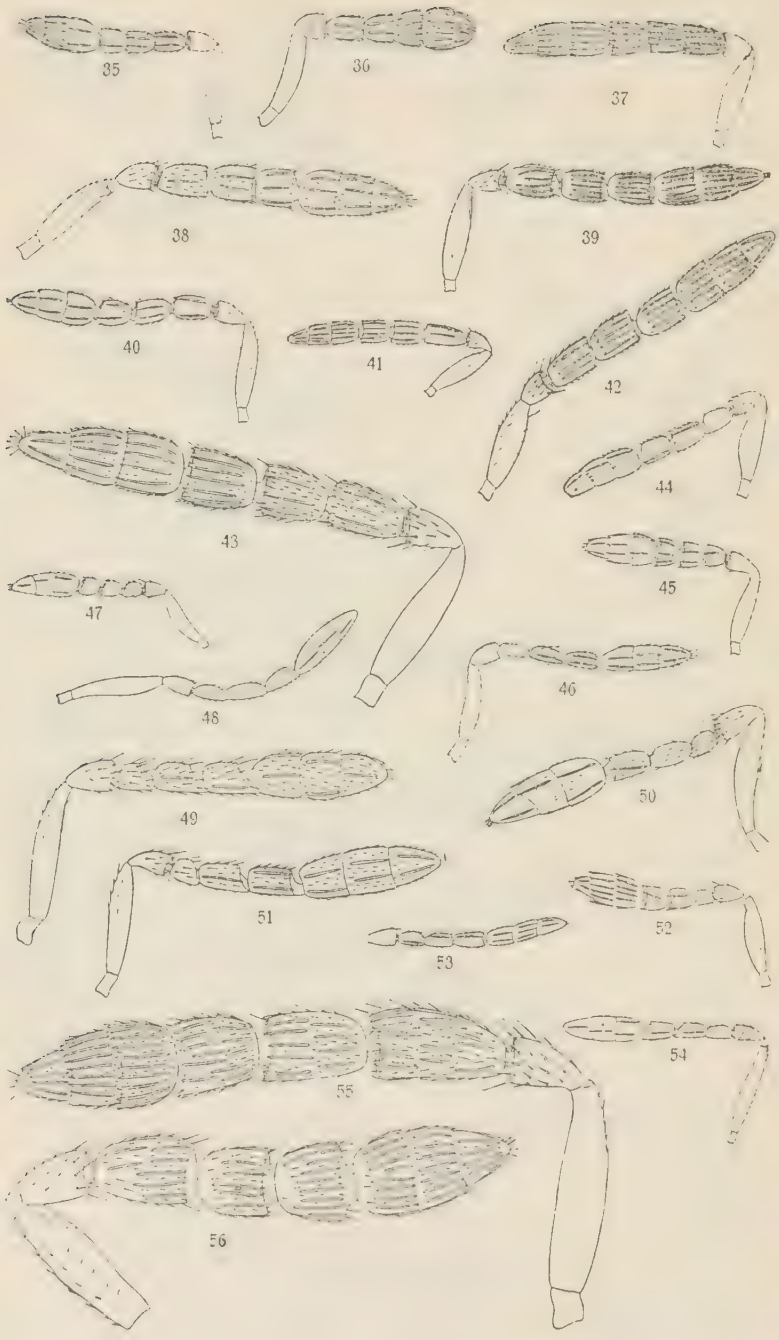


ANTENNAE OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 123

PLATE 8.

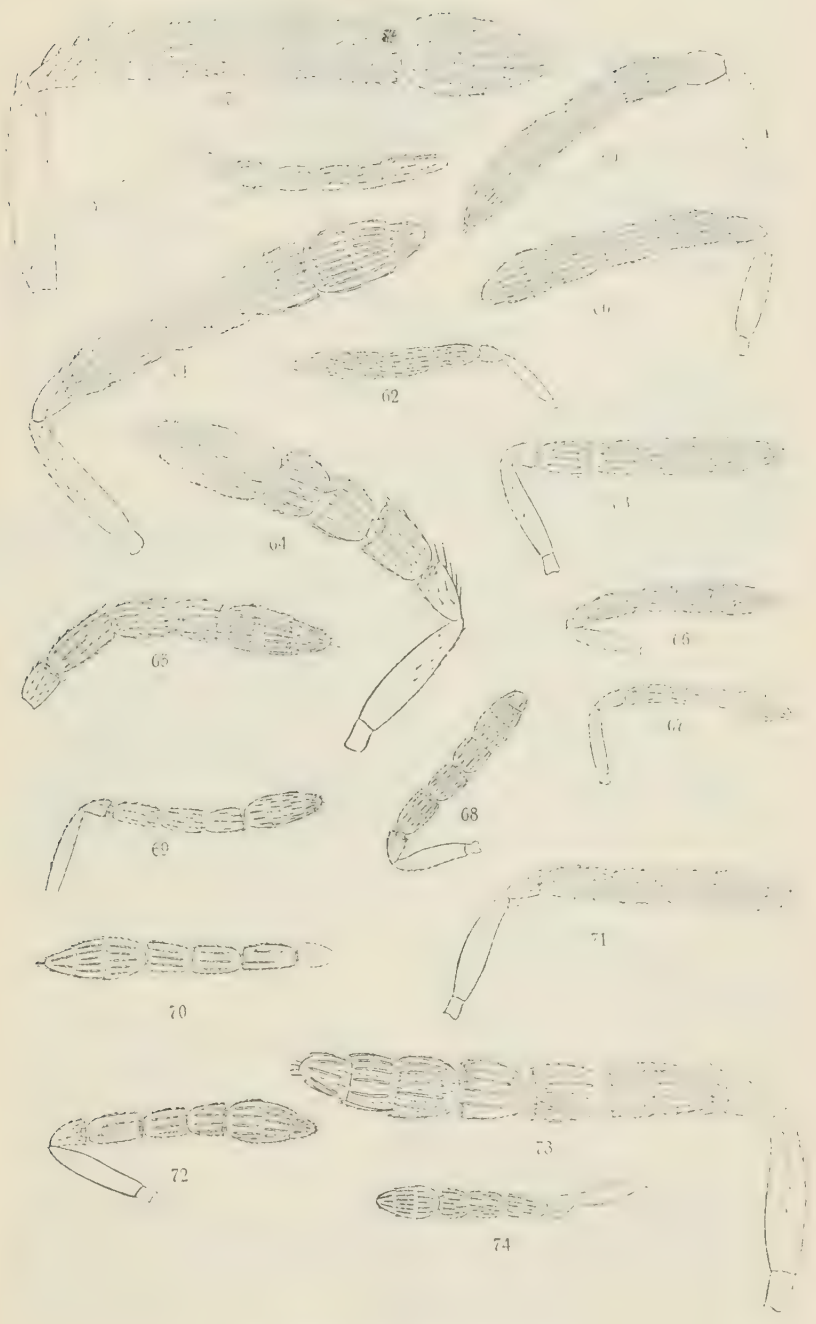
Coccophagus antennae, females

FIGURE 35. *Coccophagus leptospermi* Girault.
36. *Coccophagus inkermani* Girault.
37. *Coccophagus bogoriensis* (Köningsberger).
38. *Coccophagus cubaensis*, new species.
39. *Coccophagus pulvinariae*, new species.
40. *Coccophagus japonicus* Compere.
41. *Coccophagus hawaiiensis* Timberlake.
42. *Coccophagus tibialis*, new species.
43. *Coccophagus isipingoensis*, new species.
44. *Coccophagus zebratus* Howard.
45. *Coccophagus trifasciatus* Compere.
46. *Coccophagus perflavus* Girault.
47. *Coccophagus argenteus* Girault.
48. *Coccophagus argentifascia* Girault.
49. *Coccophagus bivittatus*, new species.
50. *Coccophagus longifasciatus* Howard.
51. *Coccophagus margaritatus*, new species.
52. *Coccophagus pulcini* Girault.
53. *Coccophagus auricaput* Girault.
54. *Coccophagus ochraceus* Howard.
55. *Coccophagus nigritus*, new species.
56. *Coccophagus modestus* Silvestri.

Plate 9

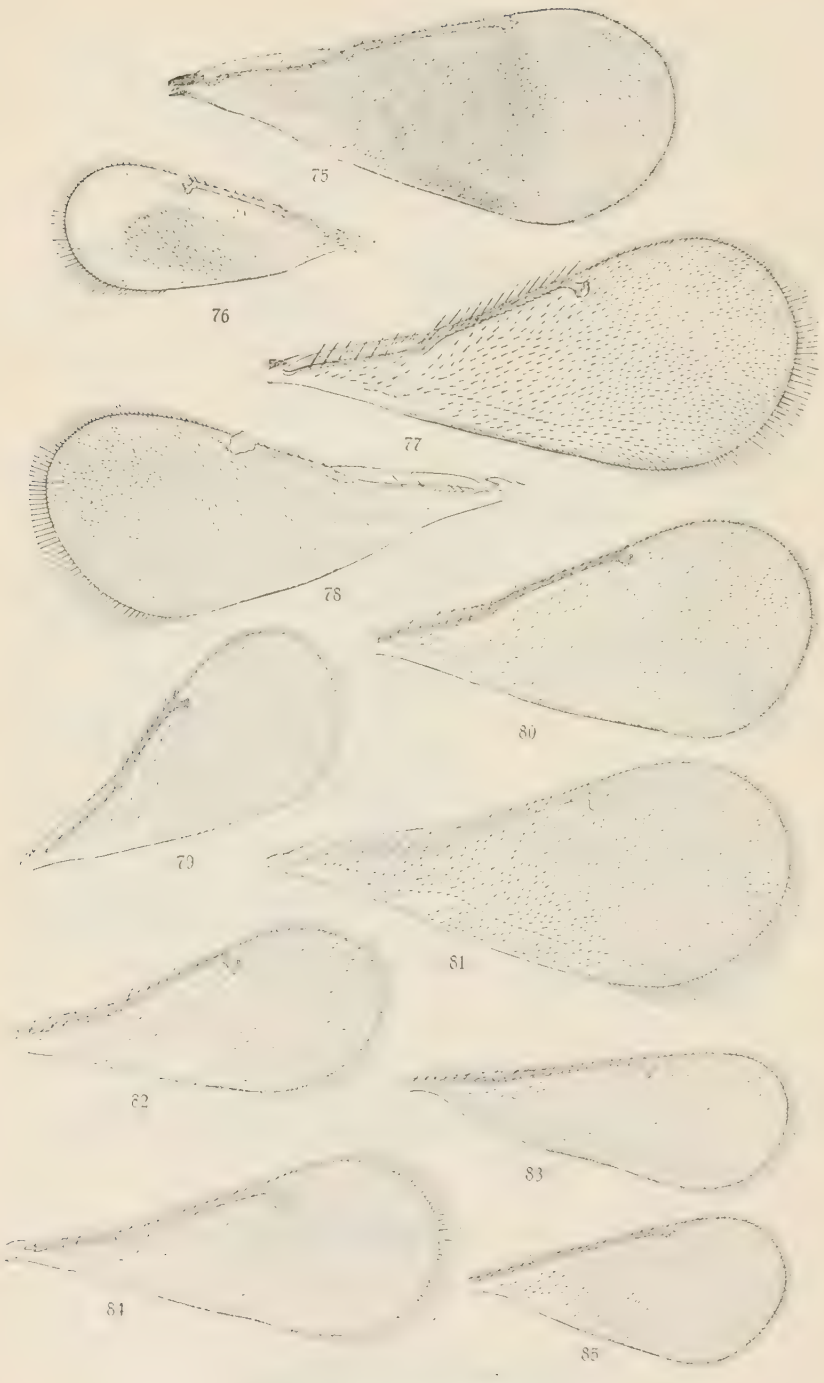
Coccophagus antennae, females

Figure 57. *Coccophagus modestus*, var. *capensis*, new variety.
58. *Coccophagus nubes* Compere.
59. *Coccophagus quaestor* Girault.
60. *Coccophagus spectabilis*, new species.
61. *Coccophagus clavellatus*, new species.
62. *Coccophagus albicoxa* Howard.
63. *Coccophagus mexicensis* Girault.
64. *Coccophagus robustus*, new species.
65. *Coccophagus saintebeauvei* Girault.
66. *Coccophagus saissetiae* Gahan.
67. *Coccophagus scutellaris* (Dalman).
68. *Coccophagus ishiii*, new species.
69. *Coccophagus scutatus* Howard.
70. *Coccophagus immaculatus* Howard.
71. *Coccophagus pulchellus* Westwood.
72. *Coccophagus howardi* Masi.
73. *Coccophagus silvestrii*, new species.
74. *Coccophagus yoshidae* Nakayama.



ANTENNAE OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 124



WINGS OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 125

Plate 10

Coccophagus fore wings, females

Figure 75. *Coccophagus rusti* Compere.
76. *Coccophagus argenteus* Girault.
77. *Coccophagus margaritatus*, new species.
78. *Coccophagus biguttatus* Girault.
79. *Coccophagus pulcini* Girault.
80. *Coccophagus javensis* Girault.
81. *Coccophagus ochraceus* Howard.
82. *Coccophagus longifasciatus* Howard.
83. *Coccophagus argentifascia* Girault.
84. *Coccophagus bivittatus*, new species.
85. *Coccophagus signus* Girault.

PLATE 11

Coccophagus stigmal veins, females

FIGURE 86. *Coccophagus nubes* Compere.
87. *Coccophagus cinguliventris* Girault.
88. *Coccophagus leptospermi* Girault.
89. *Coccophagus trifasciatus* Compere.
90. *Coccophagus clavellatus*, new species.
91. *Coccophagus zebratus* Howard.
92. *Coccophagus ishiii*, new species.
93. *Coccophagus argentifascia* Girault.
94. *Coccophagus quaestor* Girault.
95. *Coccophagus tarongaensis*, new species.
96. *Coccophagus mexicensis* Girault.
97. *Coccophagus perhispidis* Girault.
98. *Coccophagus bogoriensis* (Köningsberger).
99. *Coccophagus flavifrons* Howard.
100. *Coccophagus yoshidae* Nakayama.
101. *Coccophagus inkermani* Girault.
102. *Coccophagus auricaput* Girault.
103. *Coccophagus triguttatus* Girault.
104. *Coccophagus atratus* Compere.
105. *Coccophagus bivittatus*, new species.
106. *Coccophagus argenteus* Girault.
107. *Coccophagus immaculatus* Howard.
108. *Coccophagus margaritatus*, new species.
109. *Coccophagus tschirchii* Mahdihassan.
110. *Coccophagus longifasciatus* Howard.
111. *Coccophagus javensis* Girault.
112. *Coccophagus rusti* Compere.
113. *Coccophagus cubaensis*, new species.
114. *Coccophagus mariformis*, new species.
115. *Coccophagus howardi* Masi.
116. *Coccophagus emersoni* Girault.
117. *Coccophagus scutellaris* (Dalman).
118. *Coccophagus saintebeauvei* Girault.
119. *Coccophagus triangulatinotus* Girault.
120. *Coccophagus signus* Girault.
121. *Coccophagus nigritus*, new species.
122. *Coccophagus robustus*, new species.
123. *Coccophagus ochraceus* Howard.
124. *Coccophagus timberlakei*, new species.
125. *Coccophagus saissetiae* Gahan.
126. *Coccophagus flaviceps*, new species.
127. *Coccophagus pulvinariae*, new species.
128. *Coccophagus anthracinus* Compere.
129. *Coccophagus silvestrii*, new species.
130. *Coccophagus isipingoensis*, new species.
131. *Coccophagus lecanii* (Fitch).
132. *Coccophagus perflavus* Girault.
133. *Coccophagus pulchellus* Westwood.
134. *Coccophagus pulcini* Girault.
135. *Coccophagus flavescens* Howard.

STIGMAL VEINS OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 126

ANATOMICAL DETAILS OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 127

Plate 12

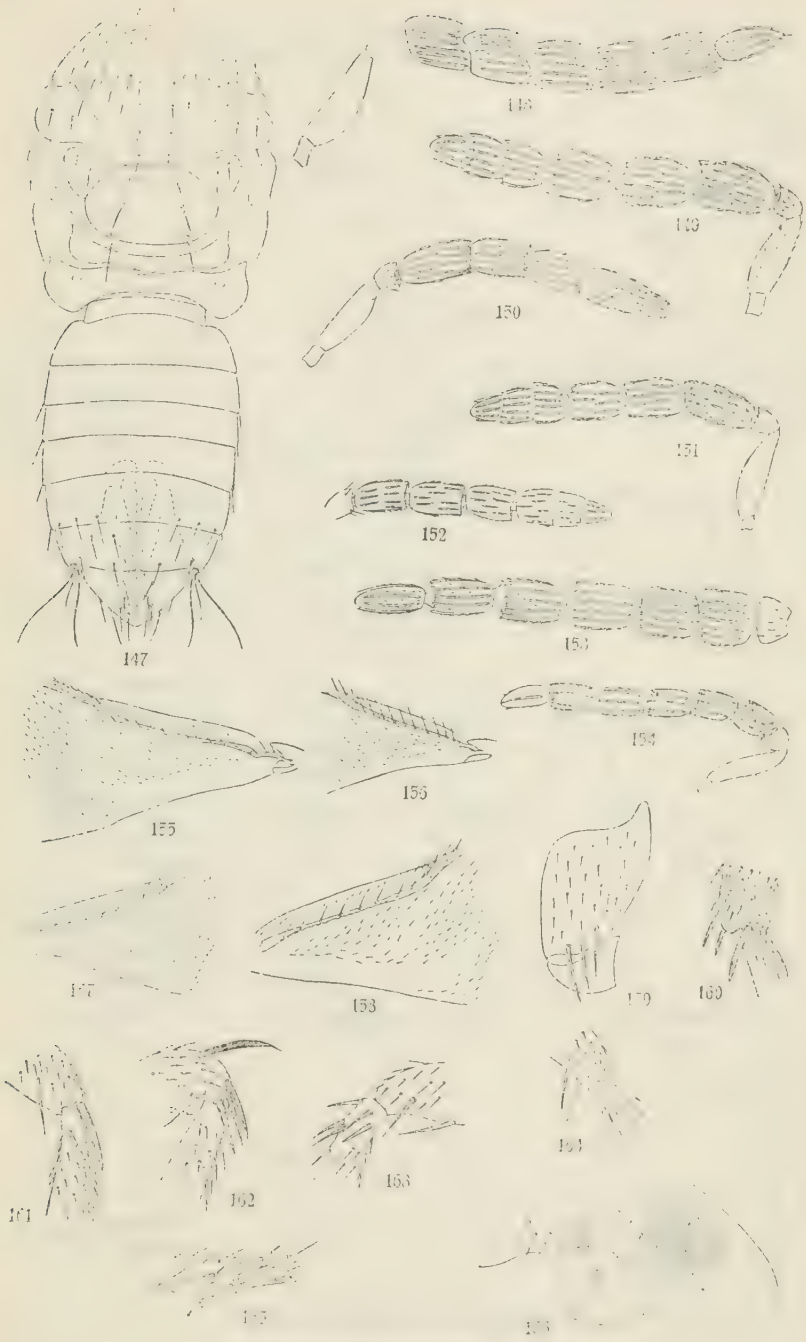
Coccophagus females and male. The drawings of the crushed and mutilated specimens shown on this plate are the outlines of the actual types as they appear on the slides.

Figure 136. *Coccophagus argenteus* Girault female.
137. *Coccophagus argentifascia* Girault female.
138. *Coccophagus redini* Girault female.
139. *Coccophagus biguttatus* Girault female.
140. *Coccophagus tarongaensis*, new species, female.
141. *Coccophagus bogoriensis* (Köningsberger) female.
142. *Coccophagus leptospermi* Girault female.
143. *Coccophagus perflavus* Girault female.
144. *Coccophagus javensis* Girault female.
145. *Coccophagus triguttatus* Girault female.
146. *Coccophagus funeralis* Girault male.

Plate 13

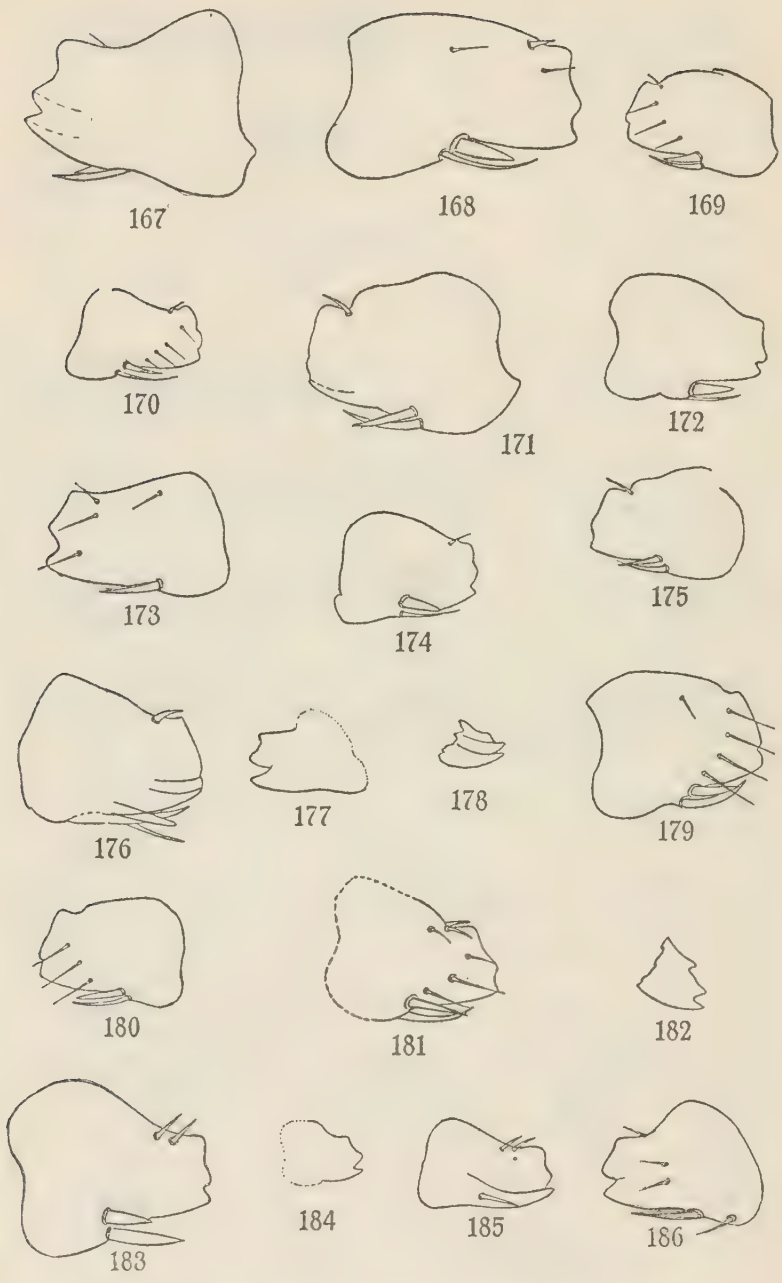
Coccophagus details

Figure 147. *Coccophagus bivittatus*, new species; body, female.
148. *Coccophagus mariformis*, new species; antenna, male.
149. *Coccophagus gregarius*, new species; antenna, male.
150. *Coccophagus leptospermi* Girault, antenna, male.
151. *Coccophagus tarongaensis*, new species; antenna, male.
152. *Coccophagus funeralis* Girault, antenna, male.
153. *Coccophagus bivittatus*, new species; antenna, male.
154. *Coccophagus margaritatus*, new species; antenna, male.
155. *Coccophagus pulchellus* Westwood; basal part of fore wing, female.
156. *Coccophagus quaestor* Girault; basal part of fore wing, female.
157. *Coccophagus mexicensis* Girault; basal part of fore wing, female.
158. *Coccophagus immaculatus* Howard; basal part of fore wing, female.
159. *Coccophagus anthracinus* Compere; setae on fore coxa, female.
160. *Coccophagus robustus*, new species; paired setae at apex of hind tibia, female.
161. *Coccophagus robustus*, new species; setae on femur and tibia, female.
162. *Coccophagus clavellatus*, new species; setae on femur and tibia, female.
163. *Coccophagus isipingoensis*, new species; setae on femur and tibia, female.
164. *Coccophagus anthracinus* Compere; setae on femur and tibia, female.
165. *Coccophagus clavellatus*, new species; hyaline break at end of submarginal vein, female.
166. *Coccophagus atratus* Compere; characteristic markings on sides of fifth and sixth tergites, female.



ANATOMICAL DETAILS OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 128



MANDIBLES OF COCCOPHAGUS

FOR EXPLANATION OF PLATE SEE PAGE 129

Plate 14

Coccophagus, mandibles, females. The mandibles shown on this plate were not uniformly oriented before drawing so that inner and outer aspects are shown.

Figure 167. *Coccophagus atratus* Compere.
168. *Coccophagus anthracinus* Compere.
169. *Coccophagus yoshidae* Nakayama.
170. *Coccophagus flaviceps*, new species.
171. *Coccophagus albicoxa* Howard.
172. *Coccophagus scutatus* Howard.
173. *Coccophagus tarongaensis*, new species.
174. *Coccophagus rusti* Compere.
175. *Coccophagus scutellaris* (Dalman).
176. *Coccophagus modestus* var. *capensis*, new variety.
177. *Coccophagus leptospermi* Girault.
178. *Coccophagus zebratus* Howard.
179. *Coccophagus nigritus*, new species.
180. *Coccophagus malthusi* Girault.
181. *Coccophagus clavellatus*, new species.
182. *Coccophagus javensis* Girault.
183. *Coccophagus gregarius*, new species.
184. *Coccophagus margaritatus*, new species.
185. *Coccophagus hawaiiensis* Timberlake.
186. *Coccophagus lepidus*, new species.

SPECIES INDEX

[Valid names appear in Roman, synonyms in italics, and the most important page reference in boldface. The generic name in brackets follows species assigned to genera other than *Coccophagus*.]

Page

abnormicornis (Girault) [Coccophagoides]--- 4
acanthosceles Waterston---------- 20, **96**
albicoxa Howard---------- 19, **91**, 92
albiscutellum (Girault) [Prospaltella]-------- 11
aleurodici (Girault) [Prospaltella]---------- 11
annulipes (Ashmead) [Aphycus]---------- 10
anthracinus Compere---------- 12, **26**, 28, 29, 86
antiopa (Girault) [Prospaltella]---------- 11
argenteus Girault---------- 17, **70**
argentifascia Girault---------- 17, **71**
argiope (Walker)---------- 10, **11**, 113
ashmeadi (Girault) [Prospaltella]---------- 11
ater Howard---------- 59
atratus Compere---------- 12, 26, 28, **29**
aurantii (Howard) [Prospaltella]---------- 10
auricaput Girault---------- 18, **79**
aureolus (Girault) [Prospaltella]---------- 11
australiensis Girault---------- 100
bifasciaticorpus Girault---------- 80
biguttatus Girault---------- 16, **63**
bivittatus, new species---------- 7, 17, **73**, 74
borgoriensis (Köningsberger)---------- 15, **51**, 53
boswelli (Girault) [Prospaltella]---------- 11
brittanicus (Girault) [Prospaltella]---------- 11
brunneus (Provancher) [Tetrastichinae genus] 10
californicus Howard---------- 59
cinguliventris Girault---------- 17, **74**
citrinus (Craw) [Aspidiotiphagus]---------- 10
clarus (Dodd) [Prospaltella] ---------- 11
clariscutellum (Girault) [Prospaltella]------- 11
clavellatus, new species---------- 19, 88, **89**
coccidis Girault---------- 59
cognatus Howard---------- 59
compressicornis (Provancher) [Tetrastichinae genus]---------- 10
cowperi Girault---------- 16, **57**, 59, 60, 63
coxalis Girault---------- 91
cubaensis, new species---------- 15, **53**, 57, 59
eleaphilus Silvestri---------- 11, 16, 57, 59, 60, **63**
emersoni Girault---------- 14, **38**
filius (Girault) [Prospaltella]---------- 11
flavescens Howard---------- 13, **31**
flaviceps, new species---------- 14, 39
flavifrons Howard---------- 12, **25**
flavoscutellum Ashmead---------- 57, 59
flavoscutellum Masi---------- 57, 63
flavovarius (Nees) [Tetrastichus]---------- 10
fletcheri Howard---------- 18, **81**
försteri (Dalla Torre) ---------- 11, **113**
fraternus Howard---------- 61
funeralis Girault---------- 11, **114**
fuscipes Howard----------11, 16, **61**
gossypariae Gahan---------- 20, **95**

Page

gregarius, new species---------- 12, 14, **41**
gurneyi Compere---------- 1, 3, **34**
hawaiiensis Timberlake---------- 16, **55**
howardi Masi---------- 10, 21, **109**
idaeus (Walker)---------- 10, 100, 109
immaculatus Howard---------- 21, 97, **106**
impeditus (Nees)---------- 10
inaron (Walker)---------- 10, 11, **113**
inkermani Girault---------- 15, 44, **50**
ishiii, new species---------- 9, 20, 98, 101, **103**
isipingoensis, new species---------- 16, **57**, 59, 60
insidiator (Dalman)---------- 10, 11, **113**
japonicus Compere---------- 15, **54**, 55, 60
javae Girault---------- 51
javensis Girault---------- 1, 14, 16, **43**
koebelei Howard---------- 25
lautus (Girault) [Prospaltella]---------- 11
lecanii (Fitch) ---------- 11, 16, 52, 53, **54**, 55, 56, **57**, **59**, 60, 62, 63, 101, 114
lecanii (Břethes)?---------- 11
lecanii A. E. Smith---------- 59
lepidus, new species---------- 12, **23**
leptospermi Girault---------- 1, 9, 15, 34, **48**
longifasciatus Howard---------- 7, 17, 73, **74**
lucani Girault---------- 11, **114**
lunulatus Howard---------- 59, 99
lutescens, new species---------- 17, **67**, 68
lycimnia (Walker)---------- 10, 100
magniclavus (Girault) [Prospaltella]---------- 11
malthusi Girault---------- 8, 9, 12, 19, 85, 88, **89**
margaritatus, new species---------- 17, **76**
mariformis, new species---------- 8, 12, 13, **36**
mexicanus Girault---------- 20, **92**
mexicensis Girault---------- 20, **93**, 95, 97
modestus Silvestri---------- 18, **82**, 86, 87, 96
modestus var. capensis, new variety------ 18, 81, **83**
moeris (Walker)---------- 10, 11, **113**
niger Masi---------- 20, **93**
nigrifrons Wallaston---------- 11, **114**
nigritus, new species---------- 18, **81**
nigriventris (Girault) [Prospaltella]---------- 11
nigropleurum Girault---------- 21, **111**
notatus (Ratzeburg)---------- 10, 11, **113**
nubeculus Břethes---------- 11, **114**
nubes Compere---------- 18, **83**
obscurus Westwood---------- 10, 11, **113**
ochraceus Howard---------- 3, 18, 43, 44, 69, **80**
orientalis (Howard) [Aneristus]---------- 10
pallipes (Provancher) [Sympiesis]---------- 10
pantherinus ? Giraud---------- **115**
perbellus (Girault) [Prospaltella]---------- 11
perflavus Girault---------- 17, **68**
perhispidis Girault---------- 13, **33**, 44, 50, 51

	Page
perpulchellus (Girault) [Prospaltella]	11
perseus (Girault) [Prospaltella]	11
picithorax (Girault) [Prospaltella]	11
poei Girault?	11, **114**
princeps Silvestri	19, 88, **89**
pulchellus Westwood	10, 21, 100, **107**, 113
pulcini Girault	18, 44, 48, **78**
pulliclavus (Girault) [Prospaltella]	11
pulvinariae, new species	15, 16, **53**, 57, 59, 60
purpureus Ashmead	11, **114**
quaestor Girault	20, 95, **97**
redini Girault	8, 12, **21**
regulus (Girault) [Coccophagoides]	4
robustus, new species	20, **96**
rusti Compere	12, **30**, 35
sainteveauvei Girault	18, **85**
saissetiae Gahan	20, 93, **98**
schilleri (Girault) [Prospaltella]	11
scutatus Howard	20, **104**
scutellaris (Dalman)	10, 20, 39, 59, 98, **99**, 103, 114
scutellaris (Föerster)	♂♀109
scutellaris (Walker)	100, 109
semicircularis (Föerster) [Aphelinus]	10, 99
seminigriclavus (Girault) [Prospaltella]	11
signus Girault	13, **35**
silvestrii, new species	21, **111**
singularis (Girault) [Coccophagoides]	4
sophia (Girault and Dodd) [Prospaltella]	11
specialis, new species	15, **46**
speciosus, new species	19, 87, **88**, 96
spectabilis, new species	**86**
subochraceus (Howard) [Euxanthellus]	11
swifti (Girault) [Prospaltella]	11
tarongaensis, new species	13, **34**
taschirchii Mahdihassan	14, **41**
tennysoni Girault?	11
thoreauini (Girault) [Prospaltella]	11
tibialis, new species	16, 53, **56**
timberlakei, new species	12, 26, **28**, 29
triangulatinotus Girault	9, 15, 44, **47**, 48
trifasciatus Compere	8, 16, **66**
triguttatus Girault	9, 14, 15, 33, **44**, 46, 47, 48, 78
unifasciata (Girault) [Prospaltella]	11
varicornis (Howard) [Physcus]	10
viridus Howard	59
xanthostictus (Ratzeburg)	99
yoshidae Nakayama	20, **94**
zebratus Howard	8, 16, 43, **64**

FOSSIL DECAPOD CRUSTACEANS FROM MEXICO

By Mary J. Rathbun

Associate in Zoology, United States National Museum

The collection here described was, with one exception, given to the United States National Museum by the Aguila Oil Co. of Tampico. It represents two different faunas, one from eastern Mexico obtained by Dr. T. W. Vaughan (unless otherwise noted) and the other from Lower California collected by Dr. W. S. W. Kew. The former has affinities with the faunas of the southern United States, the West Indies, and Panama; the latter has, so far as species go, a fauna of its own.

Species from eastern Mexico

Harpactocarcinus americanus Rathbun	Eocene.
Xanthosia americana, new species	Oligocene.
Scylla costata Rathbun	Miocene or Oligocene.
Podophthalmus (?), species	Cretaceous.
Calappa zurcheri Bouvier	Oligocene.
Calappa flammea (Herbst)	Oligocene.
Raninoides mexicanus, new species	Miocene.
Callianassa pellucida Rathbun	Miocene.
Callianassa pustulata Withers	Eocene.

Species from Lower California

Lobonotus mexicanus, new species	Eocene.
Montezumella tubulata, new genus and species	Eocene.
Calappilia hondoensis, new species	Eocene.
Ranina (?), species	Eocene.
Callianassa tepetatensis, new species	Eocene.

Family XANTHIDAE

HARPACTOCARCINUS AMERICANUS Rathbun

Harpactocarcinus americanus Rathbun, Proc. U. S. Nat. Mus., vol. 73, 1928, art. 6, p. 3, pls. 2 and 3; Texas, Eocene.

Occurrence.—Zardo Creek, about 100 meters downstream from No. 108; Eocene; 1920; Coll. No. M 115 V; a fragmentary carapace with arm.

LOBONOTUS MEXICANUS, new species

Plate 1

Description of holotype.—The length of the carapace equals the width at the tip of the third or hepatic tooth. The surface is divided into a certain number of elevations all of which, as well as the marginal teeth, are surmounted by coarse granules. A median furrow runs from the mesogastric region to the frontal emargination. An oblique ridge occupies the hepatic region, and a larger one parallel to it fills the epibranchial region; a small crescentic furrow defines the inner branchial lobe, and a larger swelling occupies the remainder of the branchial region; a long narrow lobule is above and parallel to the margin of the intestinal region. Antero-lateral margin thick, fourth tooth much the largest, second tooth below the level of first and third. Front deflexed at the middle, outer corner turned down and separated by a groove from the obtuse inner angle of the orbit; two superior orbital furrows and one inferior and lateral.

Outer margin of ischium-merus of the endognath of the external maxilliped concave, ischial furrow deep and wide. Merus of cheliped with a large spine (broken off) on the upper margin distant from the extremity; upper-outer surface of carpus large, longer than wide, surface rough with tubercles or broken-off spines, a groove parallel to distal margin. Palm with straight lower margin, outer surface very convex from top to bottom and with longitudinal rows of spines or tubercles; fixed finger elongate (broken), inclined a little downward toward the tip. Outer ends of first segment of male abdomen oblique, of second segment slightly convex, of third segment angled; sides concave from third to seventh segment, the latter subtriangular, broader than long and broadest beyond the articulation.

Measurements.—Total length of carapace 33.8, width of same 39.7, fronto-orbital width 22.2, width of front 11.2 mm.

Occurrence.—Lower California: Ranchito on south side of Arroyo Colorado between ranches Matanzo and Colorado; upper Eocene; November 11, 1920; Coll. No. 9692. The holotype shows upper and lower surfaces of the body, a portion of the left cheliped and fragments of the legs. Cat. No. 371096, U. S. N. M.

Relation.—Carapace narrower than in *L. sculptus* A. Milne Edwards,[1] from the upper Oligocene [2] of Haiti, antero-lateral teeth shallow, thick and blunt, instead of spiniform, the epigastric lobes narrow instead of wide, the immovable finger only slightly deflexed.

[1] Ann. Sci. Nat., Zool., ser. 4, vol. 20, 1863, pl. 10, figs. 1–1*b*; ser. 5, vol. 1, 1864, p. 40.

[2] According to Glaessner in Pompeckj's Fossilium Catalogus, 1, Animalia, part 41, 1929, p. 451. A. Milne Edwards gives middle Tertiary, while the specimens in the Museum of the Philadelphia Academy of Natural Science were labeled "probably lower Miocene" by their collector.

While the lobules of the carapace correspond generally to those of *sculptus*, there are above the posterior margin 2 lobules separated on the median line, but in *sculptus* one continuous elevation. The form of the abdomen and the ornamentation of the cheliped are similar in the 2 species although the cheliped of *mexicanus* may be less rough.

XANTHOSIA[3] AMERICANA, new species

Plate 6, Figure 1

Description.—A very small carapace embedded in a hard matrix. Approximate length 3.4, width 6 mm. The fronto-orbital margin is nearly as long as the middle width of the carapace excluding spine; the greater part appears to be occupied by the orbits; there is a stout lateral spine, broken off; postero-lateral longer than antero-lateral margin. Surface well areolated; summit of areoles minutely granulated. Cardiac region nearly occupied by two round areoles; mesogastric region narrowly constricted, almost subdivided at middle, the anterior areole linear-oval, the posterior areole narrow triangular, not wholly separated from the roundish elevations at the posterior angles of the region; protogastric lobes swollen but undivided; three areoles crowded together at the inner angle of the branchial region, the outermost one the largest; in front of these an acute ridge runs across the branchial region in an obliquely transverse direction from the protogastric region to the lateral margin where it forms the axis of the large lateral spine. Between the spine and the tooth at the outer angle of the orbit there are two teeth on the antero-lateral margin. The true postero-lateral margin is visible and shows four sinuses separated by shallow teeth, indicating the position of the ambulatory legs. The details of front and orbit are not clear, but the orbit is seemingly defined by the thickened outer angle of the front; two closed orbital fissues. A low swelling is present behind each frontal lobe.

Occurrence.—Cortez pump station, Tepetate, 200 meters N. E. of S. W. slope of hill; altitude about 50 meters; Oligocene; November 17, 1920; Coll. No. M 23 V; holotype, Cat. No. 371098, U. S. N. M.

Relation.—This species has the same general form as *X. gibbosa* Bell,[4] the type species of the genus. It has the strong spine or protuberance at the lateral angle seen in *X. granulosa* (McCoy).[5]

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[3] *Xanthosia* is referred provisionally to Fam. Dynomenidae by Glaessner, Fossilium Catalogus, 1, part 41, 1929, pp. 401 and 428.

[4] Mono. Fossil Malac. Great Britain, part 2, London, 1862 (1863), p. 3, pl. 1, figs. 4–6.

[5] Idem, p. 4, pl. 1, fig. 13.

Family ATELECYCLIDAE

MONTEZUMELLA, new genus

Atelecyclidae nov. gen. GLAESSNER, Fossilium Catalogus, 1, part 41, 1929, p. 446.

In shape and ornamentation of carapace resembling *Erimacrus*, but differing in the orbit which is broadly tubular viewed from above, concealing the eye. Postero-lateral margins of carapace unarmed. *Cancer fraasi* Lörenthey[6] belongs apparently in this genus and may be known as *Montezumella fraasi.*

MONTEZUMELLA TUBULATA, new species

Plate 2

Description.—Carapace suborbicular, a little longer than wide, widest at the middle; fronto-orbital distance great, more so than the posterior margin. Regions plainly indicated by broad furrows, gastric region divided into subregions, a curved furrow on the anterior branchial region. On the anterior half of the hepatic region there is a small, low, conical elevation. The mesogastric region is continued to the frontal margin, where it is depressed below the neighboring surface; parallel to the mesogastric furrows there is on each side a shallow groove leading from the outer margin of the submedian frontal tooth. The dorsal surface is covered with irregular tubercles or large granules. The fronto-orbital and antero-lateral margins are dentate, the teeth that remain being denticulate, each denticle tipped with a short, stout, movable spine. The median sinus of the front is deep U-form; on either side is a transversely oblong, ascending tooth each with 3 denticles at the extremity and an indication of one on the inner margin. Next to the submedian tooth and separated by a sinus narrower than the median one, there is an inner orbital tooth, rectangular in cross-section,[7] low and broad, and armed with 4 divergent spines. A broad rounded sinus separates this tooth from the outer orbital tooth or lamina; this is very broad, its free margin forming part of the antero-lateral slope; on the dorsal surface there is a closed fissure at the outer third; the free edge is spined. A cross-section of the orbit is shown on the left side; it is broad oblong with the corners rounded; the eye is short and stout. The 4 antero-lateral teeth of the carapace are known only from cross-sections (pl. 2, fig. 1); the third is the widest, the first and second of subequal width, the fourth narrow and thicker than the others. Lower surface of carapace granulate, the granules running smaller and closer than on the dorsum. Pterygostomian region and ster-

[6] Math.-naturw. Ber. aus Ungarn, vol. 25, 1907 (1909), p. 141, pl. 2, figs. 3*a* and 3*b*.
[7] Shown in plate 2, figure 2, on the left side.

num finely punctate and with low, flat granules. Lower border of orbit, buccal cavity and abdomen not known. The merus of the cheliped is massive, a cross-section near the large end is irregularly oblong (pl. 2, fig. 1, left). A cross-section of a palm (pl. 2, fig. 1) indicates 5 rows of spines on outer surface. A portion of a finger remains; the outer margin is armed with stout spines pointing distad; of 3 prehensile teeth preserved 2 are large, separated by a small one; a strong ridge (either dentate or spinate) lies nearest to the prehensile edge. The merus of the legs is elongate, slightly compressed, sides subparallel, a longitudinal groove through the middle of the anterior (under) side (pl. 2, fig. 3).

Measurements.—Male holotype, median length of carapace 43, extreme length of carapace 46.3, width of carapace 45.6, fronto-orbital width 15 mm.

Occurrence.—Lower California: Ranchito on south side of Arroyo Colorado between ranches Matanzo and Colorado; upper Eocene; November 11, 1920; Cat. No. 371095, U.S.N.M.

Family PORTUNIDAE

SCYLLA COSTATA Rathbun

Plate 3

Scylla costata RATHBUN, Publ. 291, Carnegie Inst. Washington, 1919, p. 170, pls. 4 and 5, pl. 6, figs. 3–5; Dominican Republic, probably Lower Miocene.—WITHERS, Ann. Mag. Nat. Hist., ser. 9, vol. 14, 1924, p. 229, pl. 6, figs. 1 and 2; Anguilla, Upper Oligocene.

Two right chelae of small specimens, palms respectively about 30.8 and 22.3 long, measured from the interdigital sinus along middle of palm. The larger chela has a palm similar in shape to that of the holotype, while the smaller one (pl. 3) is squarer, approaching that figured by Withers.

Occurrence.—Mexico; origin obscure. Original numbers 201 and M 159 C.

PODOPHTHALMUS (?), species

Plate 4, Figure 2

Description.—One specimen shows a portion of a carapace and the general outline of the left half; also the basal portion of the left eyestalk. Estimated length of carapace 22, estimated width 51 mm. Orbital margin very oblique, edge blunt; surface of orbit showing in front of it, in dorsal view. Lateral margin of carapace very sinuous, surface steeply inclined above the postlateral sinus, much as in *P. vigil* (Fabricius), a Recent and Pleistocene form. Carapace very incomplete and much broken.

Occurrence.—Villagran, Tamaulipas, on Rio Santa Lucia; in shale; upper Cretaceous series; November 8, 1920; Coll. No. M 10 V.

Relation.—Compare *P. domingensis* Rathbun, Haiti, lower Miocene.[8]

Family CALAPPIDAE

CALAPPA ZURCHERI Bouvier

Plate 4, Figure 3; Plate 5, Figure 3

Calappa zurcheri Bouvier, Bull. Mus. Hist. Nat., Paris, vol. 5, 1899, p. 189, text-fig.; Panama, Miocene.

Description.—Carapace narrow and high; at the summit is one of the largest tubercles; behind it are 3 median tubercles, the first and third of which are of medium size, the second very small; in front of the large median tubercle and on either side is a large gastric tubercle; from each of these an irregular row of 6 unequal tubercles extends to the postero-lateral angle of the carapace. Between this and the median row there is a curved row of 6 directed from the inner branchial angle toward the tooth on the postero-lateral margin; the second tubercle is larger than the others. On the antero-lateral slope are 8 tubercles in 3 vertical rows, and nearly all of good size. There are several other small scattered tubercles. The front part of the carapace is obscure, although the position of the orbits can be made out (pl. 5, fig. 3). The posterior margin has a small lobe either side of the middle; outside it begins the slightly projecting wing, of which the first two or most posterior teeth are lobiform, the next two subtriangular, dentiform, and projecting laterally, the most anterior of all the most acute and marking the widest point of the carapace.

C. zurcheri is said to be widest at the third clypeal tooth, counting from behind. This seems to be true of the left side of the figure given by its author, the fourth tooth being broken off. A glance at the right side shows the fourth tooth extending laterally beyond the third. This is the case with the Mexican specimen, which there is little doubt is conspecific with the Panamian.

Measurements.—Approximate length of carapace 31, width 42.4 mm.

Occurrence.—Transcontinental R. R. east of Los Naranjos; third horizon below *Lepidocyclina gigas;* Oligocene; November 18, 1920; Coll. No. M 33 V.

CALAPPA FLAMMEA (Herbst)

Cancer flammeus Herbst, Natur. Krabben u. Krebse, vol. 2, 1794, p. 161, pl. 40, fig. 2; vol. 3, pt. 3, 1803, p. 19.

Calappa flammea Bosc, Hist. Nat. Crust., vol. 1, 1802, p. 185.

[8] Publ. No. 291, Carnegie Inst. of Washington, 1919, p. 175, pl. 2, figs. 7 and 8.

Calappa marmorata LATREILLE, Hist. Nat. Crust., vol. 5, 1803, p. 392. Not *Cancer marmoratus* Fabricius, Mant. Insect., vol. 1, 1787, p. 319; nor Herbst, Natur. Krabben u. Krebse, vol. 1, 1790, p. 261, pl. 20, fig. 114, which is a *Pachygrapsus*.

Occurrence.—Cortez pump station, Tepetate, 200 meters N.E. of S.W. slope of hill; altitude about 50 meters; Oligocene; Nov. 17, 1920; Coll. No. M 23 V; a piece of the major finger of a small specimen.

Genus CALAPPILIA A. Milne Edwards

Calappilia A. MILNE EDWARDS, in Bouillé, Paléontologie de Biarritz et de quelques autres localites des Basses-Pyrénées, Compte-rendu des travaux du Congrès Scientifique de France, session 39, Pau, 1873, p. 434 [8]. Genotype, *C. verrucosa* A. Milne Edwards.

Carapace not extended over the ambulatory legs and without large lateral spines. Front very narrow, having 2 small, slightly divergent points, much like those of *Calappa*.

CALAPPILIA HONDOENSIS, new species

Plate 5, Figures 1 and 2

Description.—Carapace exposed, margin incomplete; broader than long, very convex, especially in the antero-posterior direction. Lateral margin strongly arched, and unarmed back to a small postero-lateral tooth which does not project as far as the line of the lateral margin or the hind margin; the latter is obscure. The longitudinal furrows separating the median area from the lateral are broad and deep. Surface covered with tubercles unequal and well separated; about 45 on the branchial region, 11 of which follow the margin; on the cardiac region an elongate median tubercle surrounded by 8 smaller ones regularly placed, and behind this pattern a single large one; 2 small urogastric tubercles side by side; 2 largest of all are median on the gastric region, in front of them an arc of 4, and in addition several smaller ones. The anterior border of the carapace is absent; on the right side, however, one gets a hint of the position of the orbit. A narrow strip visible below the side margin of the carapace is finely granulate.

Measurements.—Greatest width of carapace 18.7, width at postero-lateral tooth 14.8, approximate height 6.2 mm.

Occurrence.—Lower California: In Arroyo Hondo, 1 km. above junction with Arroyo Conejo; upper sandstone of Tepetate formation, Upper Eocene; December 2, 1920; Coll. No. 9695; Cat. No. 371094, U. S. N. M.

Relation.—This species in the quality of its ornamentation has a strong resemblance to the type species of the genus, *C. verrucosa*[9]

[9] A. Milne Edwards, C. R. trav. Congrès Sci. France, session 39, Pau, 1873, pl. 4, fig. 3.

from the lower Oligocene (?) of Biarritz, but the arrangement of the tubercles is different—the cardiac region has 2 median tubercles in one cluster instead of a single centred tubercle, and the inner part of the branchial region is isolated and its pattern consists of a cluster in which one tubercle is surrounded by 6 or 7; in our species the branchial region is not subdivided, nor a group of tubercles isolated. Both species have a small tooth at postero-lateral angle. A comparison of figures[10] shows a striking difference in the proportions of the carapace, *verrucosa* longer than broad, *hondoensis* broader than long. However, the author's illustration of *verrucosa*[10] does not correspond with the statement of measurement, width 9 mm., length 8; a proportionate length for our incomplete type-specimen would be 16.6, which is reasonable and in conformity with the position of the orbital angle.

Family RANINIDAE

RANINA (?), species

Plate 6, Figure 2

Description.—A fragment of an appendage resembles somewhat the left wrist or carpus of a Raninid. It shows the greater part of the outer surface and part of the upper surface; the narrow end (at the left in the figure) represents the distal articulation with the manus; the adjacent concave margin borders the manus; the article is very thick, but the inner surface is lacking. The outer surface is rough with granules of varying size, toward the lower edge becoming very fine and then disappearing. On the upper surface which curves over inward, granules are few and scattered; 7 in all and 2 tubercles. The greatest length of the fragment is 19.8 mm.

Occurrence.—Lower California: In Arroyo Hondo, 1 km. above junction with Arroyo Conejo; upper sandstone of Tepetate formation, upper Eocene; December 2, 1920; Coll. No. 9695.

Although it is impossible to place this specimen definitely, its shape and ornamentation will permit future identification.

RANINOIDES MEXICANUS, new species

Plate 4, Figure 1

Description.—The exact position of this species is problematic. The general form of the carapace behind the spine on the anterior portion of the side margin is urn-shaped; spine directed forward and slightly outward; a broad rounded sinus within or anterior to

[10] A. Milne Edwards, C. R. trav. Congrès Sci. France, session 39, Pau, 1873, pl. 4, fig. 3.

the spine and an appreciable narrowing of the carapace at this point. Surface covered with very fine granules placed rather near together.

Measurements.—Width of carapace just in front of the spine 10 mm., width just behind the spine 11 mm.

Occurrence.—Tuxpan, State of Vera Cruz; highest beds, Hill C; Miocene; S. Smith collector; one specimen showing portion of carapace including the base of the posterior of the lateral spines on each side; holotype, Cat. No. 371092, U. S. N. M.

Family CALLIANASSIDAE

CALLIANASSA PELLUCIDA Rathbun

Callianassa pellucida RATHBUN, Publ. 291, Carnegie Inst. of Washington, 1919, p. 165; Anguilla, West Indies; Oligocene.

Occurrence.—Zacamixtle, Tuxpan, State of Vera Cruz; November 19, 1920; Miocene: Bed at top of Azteca Incline; Coll. No. M 35 V; one right movable finger and fragments of a left movable finger, free from matrix; also several fragments embedded. Beds 25 to 35 feet above top of Azteca Incline; Coll. No. M 37 V; portion of finger embedded in matrix.

CALLIANNASSA PUSTULATA Withers

Callianassa pustulata WITHERS, Geol. Mag., vol. 63, 1926, p. 106, pl. 9, figs. 5–9; Barbados, Upper Eocene.

Occurrence.—Trail, Las Piedras to Palma Sola, by Ajoloco, 1610 m. north and 1360 m. east of Las Piedras; Eocene; December 7, 1920; M 123 V; 2 right palms and 1 left palm free from matrix, margins incomplete, height of largest one 9 mm.; also 3 palms partially embedded.

CALLIANASSA TEPETATENSIS, new species

Plate 6, Figures 3 and 4

Description.—A fragment of the palm of a right chela of large size. Outer surface very convex, inner surface relatively flat, but with a depression near the middle of the upper portion and another on the distal half of the lower surface. The margin articulating with the carpus appears to reach nearer the lower margin than the upper; it forms an obtuse angle with the upper margin. On the outer surface a little behind the fixed finger there is a cluster of large granules of which only 7 remain. From the position of the interdigital sinus, it appears that the dactyl must have been narrower at base than the fixed finger. The lower proximal half of the inner surface of the palm is covered with large flat granules near but not close together. The incomplete upper margin is rough with

13 granules (or small hair-sockets), and just below on the inner surface a row of 5 large distant sockets.

Measurements.—Approximate height 22, length from the interdigital sinus to the proximal margin measured in a line subparallel to the upper margin 22.3 mm.

Occurrence.—Lower California: In Arroyo Hondo, 1 km. above junction with Arroyo Conejo; upper sandstone of Tepetate formation, upper Eocene; December 2, 1920; Coll. No. 9695; Cat. No. 371093, U. S. N. M.

EXPLANATION OF PLATES

PLATE 1

Lobonotus mexicanus, holotype, × 1½

FIG. 1. Front view.
2. Dorsal view.
3. Ventral view.

PLATE 2

Montezumella tubulata, holotype, × 1½

FIG. 1. Right profile, showing position of antero-lateral teeth.
2. Dorsal view.
3. Ventral view.

PLATE 3

Scylla costata, right chela, × 2

FIG. 1. Lower view.
2. Inner view.
3. Outer view.
4. Top view.

PLATE 4

FIG. 1. *Raninoides mexicanus*, holotype, dorsal view of 2 fragments of carapace, × 3.
2. *Podophthalmus* (?), species, dorsal view, × 2.
3. *Calappa zurcheri*, right profile, × 1½.

PLATE 5

FIG. 1. *Calappilia hondoensis*, holotype, right profile, × 2.
2. Same specimen, dorsal view, × 2.
3. *Calappa zurcheri*, dorsal view, × 1½.

PLATE 6

FIG. 1. *Xanthosia americana*, holotype, dorsal view, × 8.
2. *Ranina* (?), species, carpus of cheliped, × 3.
3. *Callianassa tepetatensis*, holotype, outer view, × 2. The top line is at upper right of figure.
4. Same specimen, inner view. The top line is at lower right of figure.

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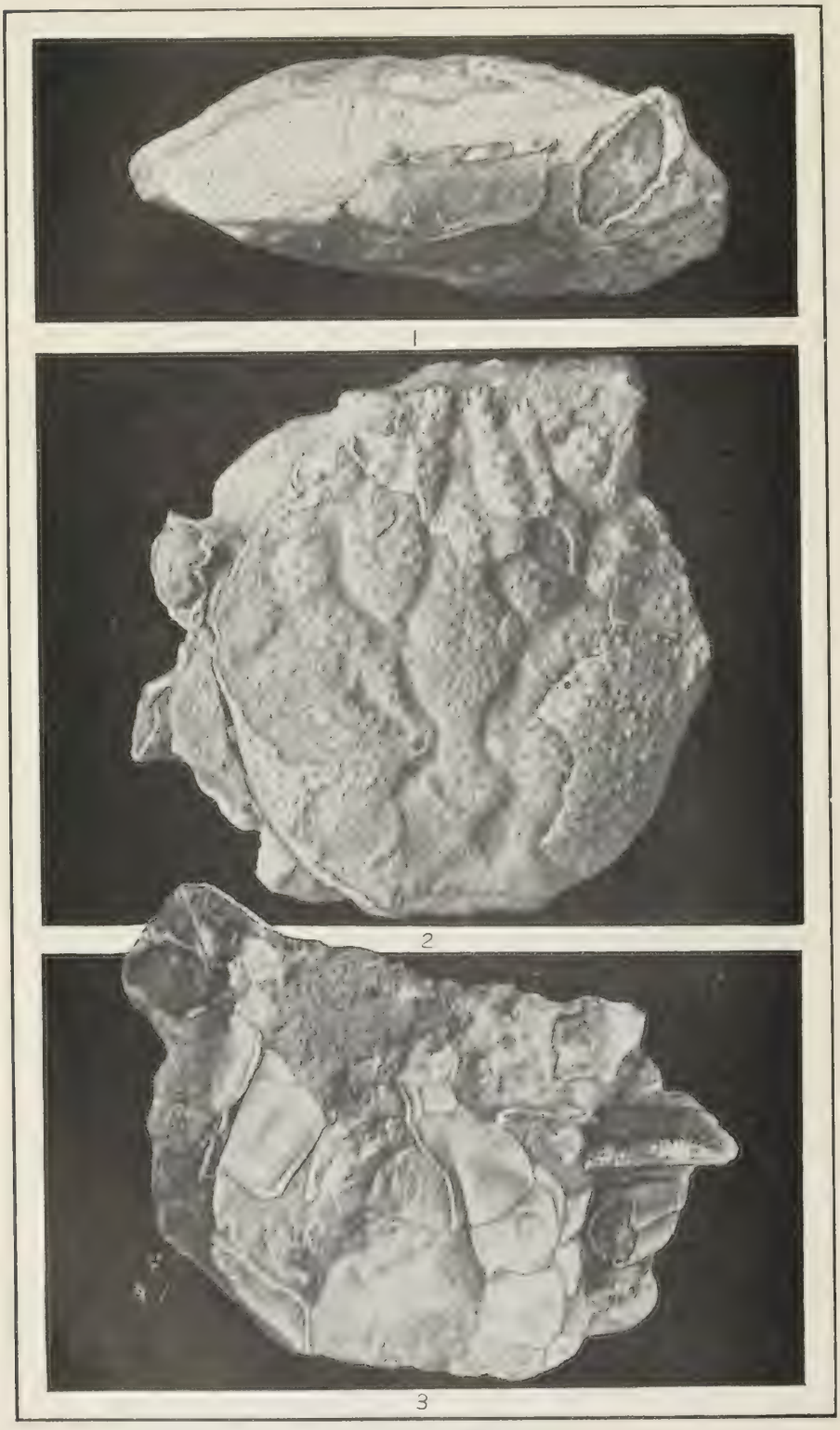
LOBONOTUS MEXICANUS

FOR EXPLANATION OF PLATE SEE PAGE 10.



MONTEZUMELLA TUBULATA

FOR EXPLANATION OF PLATE SEE PAGE 10.

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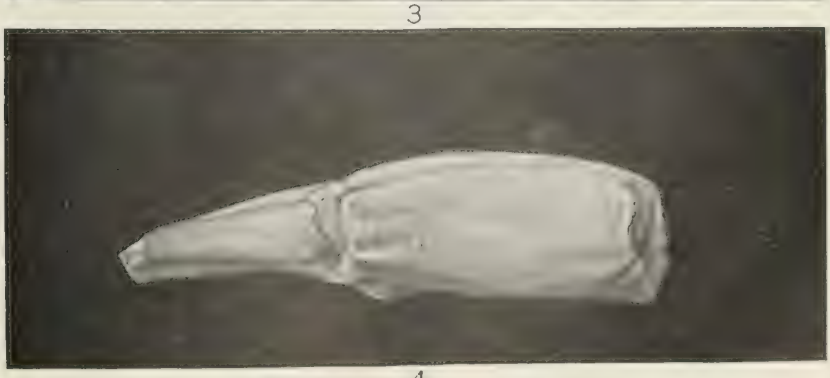

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SCYLLA COSTATA

FOR EXPLANATION OF PLATE SEE PAGE 10.

1. RANINOIDES MEXICANUS. 2. PODOPHTHALMUS (?). 3. CALAPPA ZURCHERI

FOR EXPLANATION OF PLATE SEE PAGE 10.

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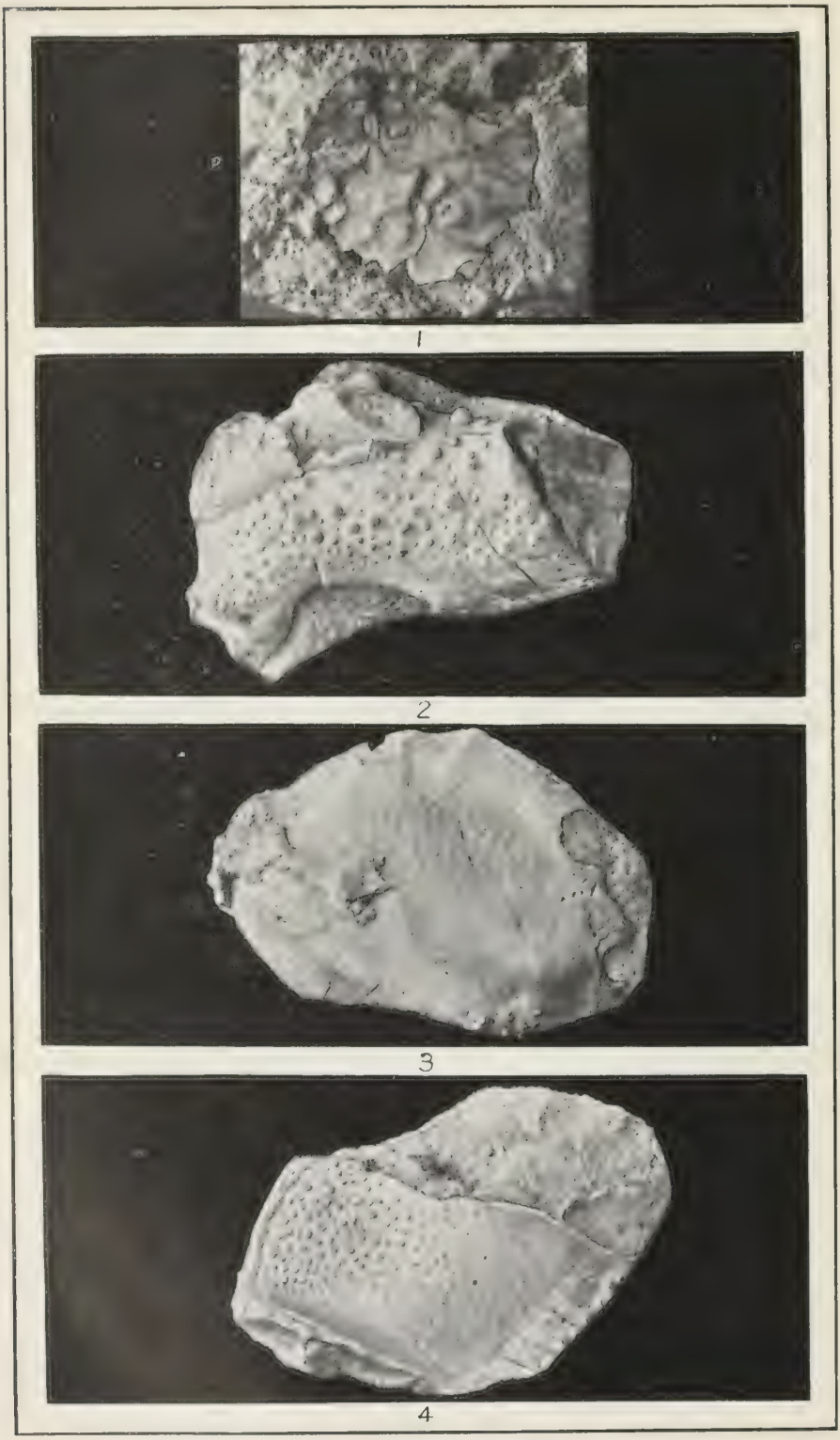
1, 2. CALAPPILIA HONDOENSIS. 3. CALAPPA ZURCHERI

FOR EXPLANATION OF PLATE SEE PAGE 10.



1. XANTHOSIA AMERICANA. 2. RANINA (?). 3, 4. CALLIANASSA TEPETATENSIS

FOR EXPLANATION OF PLATE SEE PAGE 10.

AMERICAN TWO-WINGED FLIES OF THE GENUS STYLOGASTER MACQUART

By J. M. Aldrich

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The present paper contains keys to the species of the genus, a discussion of generic and specific characters and the adult habits, and descriptions of all the known species from North and South America, 20 in number, of which 12 are new to science.

Besides the collections of the United States National Museum, important material has been examined from the American Museum of Natural History, the Museum of Comparative Zoölogy, the Canadian National Collection, and the collections of Prof. A. L. Melander and Mr. H. J. Reinhard. Credit is given under the species for the borrowed material. A small but important collection, mostly of South American specimens, which is referred to several times, was purchased a few years ago by the United States National Museum from Dr. O. Kröber, of Hamburg.

Genus STYLOGASTER Macquart

Stylogaster Macquart, Hist. Nat. Dipt., vol. 2, 1835, p. 38; Dipt. Exot., vol. 2, pt. 3, 1843, p. 174 (sep. p. 17).—Williston, Trans. Conn. Acad. Sci., vol. 6, 1883, p. 91; Kans. Univ. Quart., vol. 1, 1893, p. 120; Manual N. A. Dipt., 1908, p. 263.—Roeder, Wien. Ent. Zeit., vol. 11, 1892, p. 287.—Townsend, Ann. and Mag. Nat. Hist., ser. 6, vol. 19, 1897, p. 25.—DeMeijere, Tijdsch. v. Ent., vol. 55, 1912, p. 202.—Kröber, Ent. Mitteil., vol. 3, 1914, p. 338; Arch. f. Naturgesch., vol. 83, Heft 9, 1919, p. 40.

Stylomyia Westwood, Proc. Zool. Soc. Lond., vol. 18, 1850, p. 270.

Ptychoproctus Bigot, Revue et Magazin de Zoologie, vol. 11, 1859, p. 308.

The type species is *Conops stylata* Fabricius, it being the only one mentioned in the original publication of the genus. Macquart in establishing the genus ventured to make a figure of the species, although he had never seen it. Naturally his figure is very misleading, although interesting from a psychological standpoint. The original description of *stylata* is very brief, after the manner of the

time. Wiedemann, in redescribing it, had several other specimens, probably three species in all, and made a combined description, mixing the characters, as Williston has shown, so that it is impossible to tell what the Fabrician specimen was. Thus the matter has stood up to the present. It was assumed that the type is not now in existence: but the writer, noticing that Fabricius mentions the Schestedt collection, and recalling that this collection is now in the Zoological Museum in Copenhagen, sent to that Museum for comparison a specimen which seemed to come rather close to *stylata* in the character of the front being yellow. Dr. William Lundbeck very kindly compared it with the type and reports it to be the same. So at length the genotype of *Stylogaster* is established, and is described farther on.

The type species of *Stylomyia* is *leonum*, new, and that of *Ptychoproctus* is *complexus*, new; in both cases only one species was mentioned, and both are from South Africa. Both genera were placed in synonomy by Williston in 1883.

A list of the known species is given by Kröber in 1915 and 1919. Since 1919 the following species have been published:

bakeri Bezzi, Philippine Journ. Sci., vol. 12, 1917, p. 157.—Philippine Islands.
orientalis Brunetti, Fauna Brit. India, vol. 3, 1923, p. 272.—India.
nitens Brunetti, Ann. and Mag. Nat. Hist., ser. 9, vol. 15, 1925, p. 111.—Ashanti, Africa.
horvathi Szilady, Ann. Mus. Nat. Hung., vol. 24, 1926, p. 592.—Costa Rica. This I have included as a synonym of *stylosa* Townsend.
biannulata var. *argentina* Kröber, Konowia, vol. 8, 1929, p. 174.—Northern Argentina. This I take to be a synonym of *stylata*.
varifrons Malloch, Annals and Mag. Nat. Hist., ser. 10, vol. 5, 1930, p. 465.—S. Rhodesia, Africa.

Generic characters.—The genus *Stylogaster* is readily distinguished from the rest of the Conopidae by the very short and narrow anal cell, which is hardly as long as the second basal and is usually a little drawn in (never prolonged) on the anal vein; the long, thin, geniculate proboscis; the very narrow cheek, which is hardly visible in side view; the distinct chaetotaxy; and the striking, long ovipositor of the female. The arista is subapical, three jointed, the first two joints short. The eyes have greatly enlarged facets in the part facing directly forward, the same size in both sexes. The labella are setaceous, more or less rolled outward, and white in color. The chaetotaxy is distinct and very uniform, offering specific characters, however, in three points. The only bristles of any size on the head are a pair of postverticals, which are long, straight, parallel, and bent backward. The thorax has the following: Dorsocentral 1 (near scutellum); humeral 0 or 1; prothoracic 1; notopleural 1 or 2; supraalar 1 or 2; pteropleural 1; postalar 2; scutel-

lar 1. All these bristles are large, contrasting strongly with the insignificant hairs occurring elsewhere on head and thorax.

Specific characters.—The relative length of the second and third antennal joints; size of frontal triangle; color of front; extent of pale color bordering humerus behind and mesially; extent of pleural dark stripe; color of lateral bristles of first and second abdominal segments and of the area on which they arise; curvature of last section of fourth vein; direction of hind crossvein; length of second vein; number of humeral, notopleural, and supraalar bristles. The males show some good genitalic differences, and the female ovipositor has several striking differences in color and length of its joints. In all, these specific characters are very substantial, and good specimens of either sex are not hard to identify.

I have considered that the short apparent sixth segment forms the base of the ovipositor, making the organ three jointed; this basal joint is sometimes so closely united with the following or first long joint that the suture can hardly be made out.

The genitalia of the male are difficult to spread so that they can be described in detail. I have contented myself with such items as can be seen with comparative ease, and in describing the "forceps" have adopted the terms used in muscoids, where the posterior and anterior (or inner and outer) forceps are usually well marked. I find both these structures quite recognizable in *Stylogaster*, but of softer consistency and paler than in Tachinidae; the anterior fold diagonally across under the posterior ones in repose. The apparent seventh segment is the last and principal genital segment, the sixth being very narrow, or in rare cases retracted out of sight.

Distribution.—Two very distinct species occur in the United States, 1 of which extends into Mexico; 6 previously described species and 12 here described as new range from tropical Mexico to Brazil, Paraguay, and Bolivia; 5 are from tropical and southern Africa; 1 from India; and 1 from the Philippine Islands. No specimens have been seen or reported from the West Indies.

Habits.—Bates, in his famous Naturalist on the River Amazons, first edition, 1863 (vol. 2, p. 365), says in discussing several species of the ant genus *Eciton*, which march in large columns in the Amazon region:

> The armies of all *Ecitons* are accompanied by small swarms of a kind of two-winged fly, the females of which have a very long ovipositor and which belongs to the genus *Stylogaster* (family Conopsidae). These swarms hover with rapidly vibrating wings at a height of a foot or less from the soil over which the *Ecitons* are moving, and occasionally one of the flies darts with great quickness toward the ground. I found they were not occupied in transfixing ants, although they have a long needle-shaped proboscis, which suggests that conclusion, but most probably in depositing their eggs in the soft bodies of insects, which the ants were driving away from their hiding places. These eggs would

hatch after the ants had placed their booty in their hive as food for their young. If this supposition be correct, the *Stylogaster* would offer a case of parasitism of quite a novel kind.

Sumichrast,[1] says: "I have observed, sometimes, that little flies, of the family Syrphides, follow, flying above them, the column of *Eciton*, but can not give any account of the evolutions of these Diptera." This observation was made at Potrero, near Cordoba, Mexico.

Williston[2] says: "*Stylogaster*, it is thought, may be parasitic upon Termites."

Townsend[3] gives the following interesting account of his capture of *Stylogaster stylosa*, *ethiopa*, and *minuta*, in 1896, near San Rafael, Vera Cruz, Mexico:

Fifty-one specimens of this interesting genus were taken, hovering over the front ranks of a moving army of ants, in a "cafetal" at Paso de Telaya during the last hour or two of daylight on March 29. In company with them were numerous specimens of *Hyalomyia* and some other small tachinids. The ants have been determined by Mr Theo. Pergande as *Eciton forcli* Mayr. Mr. Pergande adds that they are the most northerly forms of that species, which is a widely distributed one in the American Tropics. The column of ants was about 15 feet wide and 25 feet long, and moved slowly but surely in a straight line through the "cafetal," swarming rapidly over the thick covering of dead leaves, branches, and other obstructions that strewed the ground under the coffee trees. The specimens of *Stylogaster* hovered continually over the ants, now and again darting at them, without doubt for the purpose of ovipositing in their bodies. During the whole three months of my collecting in this locality I saw not a single specimen of *Stylogaster* at any other time; but on this occasion, during the short time that I had before dark overtook me, I succeeded in capturing 51 specimens by sweeping closely with the net over the front ranks of the ants.

De Meijere[4] says, "Stylogaster verfolgt Termiten," and repeats the same in volume 55 (1912, p. 206), where he cites in confirmation "Bates, 1863 (vol. 1, p. 151)"; but I can find no such reference in Bates, nor in the extensive quotations from him in Hagen's monograph of the Termites.[5]

Dr. William Mann, Director of the National Zoological Park, gives me the following note regarding the species he captured in Lombardia, Honduras, in 1924 (*ethiopa*, *pectinata*, *apicalis*, and *minuta*):

The *Stylogasters* that I collected in Honduras were hovering over the front end of a column of *Eciton praedator*. At the front of such column, the ants spread out, and it seems that this is a good time for the fly to oviposit. Further along in the column the workers are much more closely massed, and it is very dangerous then for any insect to attack one.

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[1] Trans. Amer. Ent. Soc., vol. 2, 1868, p. 41.
[2] Trans. Conn. Acad., vol. 6, 1885, p. 389.
[3] Annals and Mag. Nat. Hist., ser. 6, vol. 19, 1897, p. 23.
[4] Tijdsch. v. Ent., vol. 46, 1903, p. 151.
[5] Linnaea Ent., vol. 12, 1858, pp. 270–287.

Mr. C. H. Curran, of the American Museum of Natural History, who has collected more specimens of the genus than anyone else, has kindly given me the following note on his observations in the Canal Zone:

During almost three months spent in the Canal Zone I observed representatives of the genus on several occasions, usually associated with moving armies of ants. However, as is only reasonable to expect, occasional specimens may be found disassociated from ants, and on many occasions I captured or observed them along the trails. When found singly they were hovering in small patches of sunlight, and I found them in those locations on Barro Colorado Island, Corozal, and France Field. The inference to be drawn from this is that they normally occur singly and associate themselves with the ants as the army travels, their numbers being augmented as the column moves along.

There is certainly a close relationship between the flies and the ants. However, I failed to find any trace of oviposition on the ants, although, not having read Townsend's article at that time, I arrived at the same conclusion which he had reached, namely, that certain flies darting toward the ants were ovipositing. Later observations have almost convinced me that I was wrong. The flies were observed to hover over any part of the moving column, and thus differed from the other flies associated with the ants. The Tachinids, *Oestrogaster* and *Allophora*, were almost invariably found near or in front of the head of the column, and it is reasonably certain that they oviposited in cockroaches which were "flushed" by the ants. But *Stylogaster* seemed to take no interest in these. In fact, they seemed intent only on hovering in patches of sunlight over the army.

I do not think that they oviposit on the ants, at least during the daytime. Perhaps they do in the evening. They can not be internal parasites of the army ants which I observed, because they are many times larger than the ants. If they are parasitic on the ants, it must be as predators upon the immature stages. If such is the case, the eggs might be deposited on the adult ants and carried into the nests. Assuming that this is true, Townsend's conclusions and my first one might have been correct. Both were made during the last hours of daylight. During other observations, in the morning and early afternoon, no indication of oviposition was seen.

KEY TO SPECIES OF STYLOGASTER

Males

1. Ocellar triangle long, almost or quite reaching lunule ..... 2.
   Ocellar triangle much shorter, rarely extending a little beyond middle of front ..... 5.
2. Ocellar triangle opaque; third antennal joint four or more times the second on outer side (eastern United States) ..... neglecta Williston.
   Ocellar triangle shining ..... 3.
3. Middle tibia with brush of long black hair on apical half of flexor side ..... 4.
   Middle tibia plain (Panama) ..... indistincta, new species.
4. Middle basitarsus with a row of half a dozen erect black spinose hairs on a swelling on anterior side before middle; front coxae with a tuft of hairs at tip which are black in front, pale behind (Brazil) ..... ornatipes Kröber.
   Middle basitarsus straight, without swelling but with a few black hairs on anterior side; front coxae with only a few hairs at tip (Costa Rica). decorata, new species.

5. First abdominal segment pale at sides where the lateral bristles arise____6.
   First abdominal segment dark at sides where the lateral bristles arise__13.
6. Abdomen yellow with faint brown bands on hind margins of the segments (New England to Texas)_____biannulata Say.
   Abdomen much darker_____7.
7. Third antennal joint on outer side fully three times the second; lateral bristles of first and second abdominal segments wholly pale (British Guiana)_____fasciata, new species.
   Third antennal joint not over twice the second; lateral bristles of first and second abdominal segments mostly black_____8.
8. Abdomen unusually short and broad, second segment shortened in middle of dorsum; third paler in color with a narrow transverse dark band in middle, approaching the hind margin at sides (British Guiana).
   breviventris, new species.
   Abdomen of usual form, not as described_____9.
9. Front except narrow lateral margins of uniform reddish-brown color; ocellar triangle very short, rounded off close to median ocellus; mesonotum with ill-defined median wide brown stripe (Panama).
   currani, new species.
   Front and mesonotum not as described_____10.
10. First posterior cell not wider than submarginal, last section of fourth vein nearly straight; proboscis yellow halfway to geniculation_____11.
    First posterior cell wider than submarginal, last segment of fourth vein strongly bowed; proboscis yellow only at base_____12.
11. Hind edge of last sternite with a complete transverse comb-like row of backwardly directed black spinules, and just before this a pair of small groups of black setules, less conspicuous; outer forceps swolen, white, with a long, slender yellow apical process extending across the median line (Central America)_____pectinata, new species.
    With no apparent spinules on last sternite; the outer forceps slender, with jagged tips, without such processes (Central America).
    rectinervis, new species.
12. Front coxae with brush of long pale hair at tip (Brazil)__stylata Fabricius.
    Front coxae with black hair at tip (Mexico, Central and South America).
    stylosa Townsend.
13. Last sternite with a small cluster of black setules on each side of the median rounded notch (Mexico, Central America)_____minuta Townsend.
    Last sternite not with clusters of setules_____14.
14. Middle third of hind femur and penultimate fifth of hind tibia whitish, well defined (Panama)_____banksi, new species.
    Hind femora and tibiae almost unicolorous, brownish (Honduras).
    apicalis, new species.

Females

1. Ocellar triangle long, almost or quite reaching lunule_____2.
   Ocellar triangle much shorter, rarely extending a little beyond middle of front_____5.
2. Ocellar triangle opaque; third antennal joint four or more times the second on outer side (eastern United States)_____neglecta Williston.
   Ocellar triangle shining_____3.
3. Lateral bristles of first abdominal segment wholly pale_____4.
   Lateral bristles of first abdominal segment mostly black (Peru).
   peruviana, new species.

4. Hind crossvein almost parallel with hind wing margin; hind tibiae strongly annulate with white near tip (Mexico, Central America).
ethiopa Townsend.

Hind crossvein nearly erect, hind tibiae not annulate with white (Panama).
panamensis, new species.

5. Second and third abdominal segments wholly yellow (Bolivia).
abdominalis Kröber.

Abdomen yellow with faint dark apical bands on all segments (New England to Texas)——**biannulata** Say.

Abdomen much darker——6.

6. First abdominal segment with only pale bristles at sides——7.

First abdominal segment with coarse black bristles at sides——8.

7. Second segment of ovipositor snow white and with white hair on basal half or more (Panama)——**speciosa**, new species.

Second segment of ovipositor black on basal half; front wholly yellow on anterior third or half; fourth vein greatly bowed, joining third almost at a right angle (Brazil)——**stylata** Fabricius.

8. Front uniform light reddish brown in color except narrow sides; ocellar triangle very short, hardly continuing beyond median ocellus (Panama).
currani, new species.

Front yellow on anterior edge, gradually becoming black upward; ocellar triangle equilateral, extending beyond median ocellus only about twice the width of the latter (Mexico, Central America)——**stylosa** Townsend.

Front dark, at least above; ocellar triangle more acute anteriorly——9.

9. Abdomen unusually short and broad; third segment rather pale, with narrow arcuate black crossband near middle which curves backward near sides (Dutch Guiana)——**breviventris**, new species.

Abdomen of ordinary form, not with such crossband——10.

10. Second segment of ovipositor snow white except base (Panama).
apicalis, new species.

Second segment of ovipositor not white——11.

11. Hind tibia with distinct band of white ground color on penultimate fifth (a little obscured by dark hairs) (Panama)——**banksi**, new species.

Hind tibia not banded——12.

12. The lateral black bristles of the first abdominal segment arise from a spot of dark ground color (Mexico to Central America)——**minuta** Townsend.

The lateral black bristles of the first abdominal segment arise from an area of white ground color (Central America)——**rectinervis**, new species.

STYLOGASTER STYLATA Fabricius

Conops stylata Fabricius, Syst. Antliatorum, 1805, p. 177.

Myopa stylata Wiedemann. Ausserourop. Zweifl. Insekten, vol. 2, 1830, p. 243.

Stylogaster stylata Macquart, Hist. Nat. Dipt., vol. 2, 1835, p. 39; Dipteres Exotiques, vol. 2, pt. 3, 1845, p. 174 (separate p. 17), pl. 2, fig. 3.—Roeder, Wien. Ent. Zeitung, vol. 11, 1891, p. 287.—Williston, Kans. Univ. Quart., vol. 1, 1893, p. 120.—Townsend, Annals and Mag. Nat. Hist., ser. 6. vol. 19, 1897, p. 24.—Kröber, Entom. Mitteilungen, vol. 3, 1914, p. 347; Arch. Naturgesch., vol. 83, 1917 (1919), p. 43.

Stylogaster stylosa (part) Kröber, Entom. Mitteilungen, vol. 3, 1914. p. 347.

Stylogaster biannulata var. *argentina* Kröber, Konowia, vol. 8, 1929, p. 174.

Male.—Front rather wide, velvet black above, changing to yellow a little below middle; frontal triangle almost equilateral, rounded anteriorly, reaching only to middle of front, its outer margins somewhat yellowish. Face rather wide, silvery yellow; second antennal joint a trifle longer than third, blackened on upper edge beyond base; third joint brown, reddish below and on inner side; back of head black in ground color with coarse whitish hair, becoming delicate and quite dense below near the edge of oral cavity. Mesonotum black on disk; humeri whitish, the color extending back to suture and down to front coxae as well as nearly halfway to the middle line of mesonotum. Behind the suture the dark color extends broadly down the mesopleura. Above the wings the color is yellow and there is a median divided yellow area beginning a little back of the suture. Margin of scutellum yellow, metanotum black in middle. Humeral bristle absent; notopleural only one; supra-alar one.

Abdomen mostly yellow; first segment broadly black above, the sides whitish and bearing only delicate white bristles; second segment black, the sides yellow, broadly expanded toward the middle above so that the black color is correspondingly narrowed, a stout row of black bristles laterally at the base; third, fourth, and fifth segments yellow with broad black hind margins extending forward in the middle to form a median stripe; the pale portion of the fourth segment is distinctly white pruinose; sixth segment very narrow, yellow; seventh (genital segment) largely yellow with black basal spot on each side of middle; forceps yellow, inclosing between them an oval area mostly filled with delicate pale hairs arising from the inner sides of the forceps. Front legs yellow, last tarsal joint blackened; tip of coxa with conspicuous long delicate pale hairs in front and behind. Middle legs yellow; coxae with mixed smallish pale and dark hairs. Tibia with an erect, short, black spine at tip on flexor side; tarsi black at tip and the apices of the first four segments slightly infuscated. Hind femora yellow with two brown annuli, the erect pile on the inner side extending only a little beyond middle. Hind tibia yellow, apical third except extreme tip black, inner surface with dense erect pile from above the middle. Hind tarsi black, first segment more brownish in middle.

Wing light brown, first posterior cell much widened beyond middle, last section of the fourth vein broadly curved, joining third a little before tip, the united veins joining costa rather far before apex; hind crossvein almost parallel with wing margin, longer than last section of fifth vein and almost as long as penultimate section of fourth. First posterior cell much wider than submarginal. Tip of second vein slightly farther from base of wing than anterior end of hind crossvein.

Female.—Ovipositor rather short and thick, the short basal segment blackish, following one brown, indistinctly yellow at apex; last segment black, apical half yellowish. Front coxae with ordinary smallish black bristles.

Length, male 7.5 mm., female 6.5 mm. to ovipositor, which is nearly 3 mm. long.

Redescribed from four females and one male; all but one female were taken at Santa Cruz, Rio Grande do Sul, Brazil, and were received from Dr. O. Kröber, under the name of *stylosa* Townsend, and were so mentioned by him in his revision of the genus; the other female is from San Bernardino, Paraguay (K. Fiebrig). One of the Santa Cruz females has been compared with the type in the Zoological Museum in Copenhagen by Doctor Lundbeck, who writes:

> The type of *Stylogaster stylata* Fabricius is in our collection (Schestedt Collection), but it is a very bad specimen, and the abdomen is lost, so that the important characters of this can not be identified. Otherwise the two specimens are quite alike; the color and shape of the head, the ocellar triangle, the antennae, the legs, and the venation of the wings, all are quite the same, so that I think it certain that the two specimens are the same species.

STYLOGASTER STYLOSA Townsend

Stylogaster stylosa Townsend, Annals and Mag. Nat. Hist., ser. 6, vol. 19, 1897, p. 24.—Kröber, Ent. Mitteilungen, vol. 3, 1914, p. 344 (part); Arch. Naturgesch., vol. 83, 1917 (1919), p. 44, pl. 8, figs. 55, 55*a*, 55*b*.
Stylogaster horvathi Szilady, Ann. Mus. Nat. Hung., vol. 24, 1928, p. 592, fig. 2.

Male.—Greatly resembles *stylata*, agreeing in the absence of the humeral bristle, the single notopleural, and one supraalar. Frontal triangle a little shorter, the black color of the front extends farther forward, fading gradually close to the lunule or sometimes reaching it; the second antennal joint is much blacker; the bristles on the sides of the first abdominal segment are nearly all black, arising from the white part of the segment; those at the tip of the front coxae are entirely black, the erect pile on the inner and under side of the hind femur continues to the end; and the first posterior cell is narrower, the last section of the fourth vein being much less strongly curved. The first posterior cell is, however, wider than the submarginal. The second abdominal segment is much darker; the genitalia appear to be nearly the same, the oval aperture inclosed between the posterior forceps is very distinct with its margin of pale hairs.

Female.—Ovipositor about as in *stylata*, its basal joint mostly yellow.

Length, male 6.5 mm., female 5.5 mm. to ovipositor, the latter about 3 mm.

Redescribed from 60 specimens: 25 taken by C. H. Curran, 2 by S. W. Frost, 1 by Nathan Banks, and 2 by R. C. Shannon, all on Barro Colorado Island, Canal Zone; 1 Frijoles, Canal Zone, by Nathan Banks; 1 at Tabernilla, 1 at Lion Hill, Canal Zone, collected by August Busck; 1, Cano Saddle, Gatun Lake, Canal Zone, by R. C. Shannon; 2 from Paraiso, Panama, from J. Zetek; 2 from Lombardia, Honduras, collected by W. M. Mann; 10 from La Suiza de Turrialba, Costa Rica, collected by Pablo Schild and received from Prof. A. L. Melander; 11 from Higuito, San Mateo, Costa Rica, collected by Pablo Schild; 1, Trece Aguas, Alta Vera Paz, Guatemala, collected by Schwarz and Barber.

Townsend described the species from six male and eight female specimens taken near San Rafael, Vera Cruz, Mexico. None of his types of *stylosa*, *ethiopa*, and *minuta* are in the National Museum, nor are they in the University of Kansas. Kröber mentions one cotype of *stylosa* and one of *ethiopa* in the Bezzi collection, now in the museum in Milan. Mr. Edwards, in reply to an inquiry, says that the British Museum has two or three of each of the species, presumably types, though not so marked. I am unable to trace the remainder of the type material of the three species.

STYLOGASTER BIANNULATA Say

Myopa biannulata Say, Journ. Acad. Nat. Sci. Phila., vol. 3, 1823, p. 81; Complete Works, vol. 2, 1859, p. 72.

Myopa stylata Wiedemann, Aussereur. Zweif. Ins., vol. 2, 1830, p. 243—Roeder, Wien. Ent. Zeit., vol. 11, 1892, p. 287.

Stylogaster stylata Macquart, Dipt. Exot., vol. 3, pt. 2, 1843, p. 175 (separate p. 18), pl. 2, fig. 3.—Osten Sacken, Cat. N. A. Dipt., 1878, pp. 140, 259.

Stylomyia confusa Westwood, Proc. Zool. Soc. Lond., vol. 18, 1850, p. 271, pl. 19, fig. 4. (Syn. by Loew, Schaum's Jahresbericht, 1851, p. 133.)

Stylogaster biannulata Williston, Trans. Conn. Acad., vol. 6, 1883, p. 93; vol. 6, 1885, p. 394, pl. 61, fig. 8; Kans. Univ. Quart., vol. 1, 1893, p. 120.—Snow, Kans. Univ. Sci. Bull., vol. 2, 1903, p. 216.—Tucker, Kans. Univ. Sci. Bull., vol. 4, 1907, p. 99.—Johnson, Ann. Rept., N. J. State Mus., 1909 (1910), p. 772; Bull. Amer. Mus. Nat. Hist., vol. 33, art. 3, 1913, p. 69.—Peterson, Ill. Biol. Monographs, vol. 3, 1916, fig. 359.—Britton, Check-list Ins. Conn., 1920, p. 189.—Johnson, List. Dipt. New England, 1925, p. 180.—Johannsen, List Ins. New York, 1928, p. 803.

Male.—Front rather wide, triangle shining brown, except in center, reaching to middle of front; lower third of front yellow, which extends farther up along the sides; antennae yellow, tip of third joint brown; second joint on outer side about as long as third (in one specimen only three-fourths as long). Thorax yellow, the dark mesonotal spot smaller than usual, well-defined, widely separated from lateral margins and deeply notched behind. Mesopleura with only a faint brownish mark above, which is not connected with the dorsal

spot; no humeral bristle, one notopleural, one supraalar. Scutellum with a small brown spot covering about two-thirds of the disk; metanotum with a small blackish spot, narrower than first abdominal segment.

Abdomen almost entirely yellow; first segment faintly brown above, and second to fourth segments with a faint brown posterior cross-band, not reaching the sides; first segment with only pale bristles laterally, arising from whitish ground color. Genitalia yellow, a striking row of pale hairs along the lower edge of the fifth tergite. Hairs of the abdomen quite dense and uniform, brown in color. Lateral bristles of second segment black, in a single row anteriorly. Most of the specimens of both sexes show two small brown spots on the second abdominal segment near its base.

Legs yellow, front and middle ones rather whitish. Front coxae with only pale hairs at tip; middle with mixed pale and dark. Hind femora and tibiae with the usual villosity on the inner side; hind femora yellow with two faint brown rings; hind tibiae yellow at base, whitish toward middle, the apical two-fifths decidedly black, the whitish part covered with white hairs behind. Hind tarsi brown.

Wing nearly hyaline, the first posterior cell wide beyond the middle on account of the broad curve of the last section of the fourth vein, wider than submarginal. Hind crossvein parallel with wing margin. Tip of second vein farther from base than anterior end of hind crossvein.

Female.—Ovipositor yellow on the two basal joints, the apical one black except at extreme tip, the ovipositor as a whole decidedly shorter than the remainder of the abdomen.

Length, male 6.4 mm.; female 6 mm., to ovipositor, which is about 3 mm.

Redescribed from 6 males and 14 females: One pair from the Riley collection has no locality; 1 male, Delaware (Ridings), also from Riley collection; 1 male from Texas, but collector unknown, received from Dr. O. Kröber; 1 female, Victoria, Tex., collected by E. A. Schwarz; 4 males and 8 females, College Station, Tex., collected by H. J. Reinhard; 1 female, Turkey Run, Ind., collected by J. M. Aldrich; 2 females, Chichenitza, Yucatan, Mexico, from American Museum of Natural History, differ in having largely black bristles on sides of first abdominal segment.

STYLOGASTER NEGLECTA Williston

Stylogaster neglecta Williston, Trans. Conn. Acad., vol. 6, 1883, p. 91, pl. 61, fig. 8.—Townsend, Trans. Amer. Ent. Soc., vol. 22, 1894, p. 64.—Johnson, Cat. Ins. N. J., 1899, p. 665; 1909 (1910), p. 772; List Dipt. New England, 1925, p. 180.—Snow, Kans. Univ. Sci. Bull., vol. 2, 1903, p. 216.—Jones, Canad. Ent., vol. 39, 1907, p. 251.—Williston, Manual

N. A. Dipt., 1908, p. 262, fig.—Banks, Ent. News, vol. 23, 1912, p. 109; Annals Ent. Soc. Amer., vol. 9, 1916, p. 200.—Daecke, Ent. News, vol. 24, 1913, p. 45.—Kröber, Entom. Mitteilungen, vol. 3, 1914, p. 349.—Britton, Check-list Ins. Conn., 1920, p. 189.—Johannsen, List Ins. New York, 1928, p. 803.

Male.—Easily recognized by the large, opaque, pale yellow frontal triangle, the elongate slender tip of which just reaches the lunule. The front outside the triangle is brown in color, becoming somewhat darker at vertex; the orbits are shining light yellow below, gradually changing into brown above. The antennae are also quite striking, the first antennal joint is longer than usual, second very short and the third fully four times the second and of orange color except a dark stripe along the upper edge. Mesonotum mostly black, which extends to the mesopleura behind the suture. Humeri white with a yellowish area behind to the suture and mesially halfway to the middle. Before the scutellum a yellowish area extends from one wing to the other. Humeral 1; notopleural 2; supraalar 2. Scutellum brown in middle. Metanotum with distinct black spot not reaching sides nor upper edge. Halteres with yellow knob.

Abdomen yellow, somewhat more brownish toward the apex. First segment brown above, its sides pale yellow, all the lateral bristles of the first and second segments yellow; the third, fourth, and fifth segments have a pale pollinose band at base; genital segment yellow, bearing a pair of backwardly directed black bristles standing far apart.

Front and middle legs pale yellow, tarsi gradually darker; hind femora yellow with two narrow dark rings; hind tibia yellow on basal two-thirds, then more whitish, the apical sixth or eighth quite black, as are also the tarsi. Hind trochanters and femora without villous hairs; front and middle coxae with only small pale hairs at tip.

Wing subhyaline, first posterior cell hardly wider than the submarginal cell immediately in front of it; tip of second vein much farther from base than anterior end of hind crossvein.

Female. Front and antennae as in male. Ovipositor slightly longer than the remainder of the insect, the principal joint very long and only slightly tapering, the terminal joint about three-fifths as long, black on basal half, snow white on apical half, the minute appendages at the tip darker; the hair on the last segment corresponds with the ground color. It is almost impossible to distinguish the very small basal joint.

Length, male 5.5 mm., female the same to the ovipositor, which measures 7 mm.

Redescribed from 27 specimens: 1 Wilmerding, Pa., no collector; 2 from Connecticut (Williston); 1 Riverton, N. J. (no collector, re-

ceived from Dr. O. Kröber); 4 Pemberton, Wenonah, and Riverton, N. J. (G. M. Greene); 3 Castle Rock, Pa. (G. M. Greene); 2, Auburndale, Mass. (C. W. Johnson); 1 College Park, Md. (G. M. Greene); 5 near Plummer Island, Va. (H. L. Viereck); 4 Falls Church, Va. (Nathan Banks and E. A. Chapin); 1 Magnolia, W. Va. (R. C. Shannon); 1 Anderson, Indiana (J. M. Aldrich); 1 Onaga, Kansas (Crevecoeur); 1 without locality.

STYLOGASTER MINUTA Townsend

Stylogaster minuta TOWNSEND, Annals and Mag. Nat. Hist., ser. 6, vol. 19, 1897, p. 27.—KRÖBER, Entom. Mitteilungen, vol. 3, 1914, p. 348; Archiv Naturgesch., vol. 83, 1917 (1919), p. 43.

Male.—Front rather narrow, frontal triangle shining black, reaching about halfway to lunule, remainder of the front rather uniform dark brown, hardly at all paler anteriorly; first antennal joint white, second brown, third reddish yellow, broadly infuscated at apex. Proboscis yellow almost to middle of basal joint. Mesonotum subshining black, the humeri white with only a narrow pale margin behind and mesially. Mesopleura dark brown to sternopleura. Posterior part of mesonotum opaque brownish, scutellum almost of the same color. Middle portion of metanotum black. Humeral 1; notopleural 2; supraalar 1.

Abdomen blackish, the second, third, and fourth segments with uninterrupted pale crossband basally which becomes slightly wider at the sides. First segment narrowly white at base, the lateral bristles black and rather stout, arising from a distinctly blackish spot; second segment with a single row of black lateral bristles; fifth segment shining blackish with only a slight basal, paler band, which encroaches a little on the preceding segment in the middle; sixth segment short, black; seventh segment also black. Genitalia yellow, the posterior forceps fleshy and thick, approximated to each other in most of their length. The last sternite has a very distinct rounded excavation in the middle, on each side of which is a striking patch of small black setules.

Front and middle legs pale yellow; tarsi a little darker; front coxae with some black bristles at apex in front and behind; hind femora brown with a lighter brown annulus in the middle and with dense pile below and on inner side to about the middle; hind tibia light brownish yellow with only a very faint trace of subapical lighter annulus; hind tarsi black.

Wing brownish, first posterior cell of the same width as the submarginal; second vein quite short, tip nearer the base of the wing than the anterior end of the posterior crossvein.

Female.—Front tibiae with rather striking long, pale, apical, bristles, two somewhat united and usually longer than half the

basitarsus. Ovipositor shorter than the remainder of the abdomen, yellow at base and on the side to about the middle, the principal segment about twice as long as the last one; terminal organs yellow.

Length, male 4.8 mm., female about 4 mm. to ovipositor, which is 2 mm. long.

Redescribed from 10 males and 5 females; 13 specimens were collected on Barro Colorado Island, Canal Zone (10 by C. H. Curran, 3 by Nathan Banks); 1 male, 1 female, Lombardia, Honduras (William M. Mann).

Originally described from 10 male and 7 female specimens, taken near San Rafael, Vera Cruz, Mexico. See note under *stylosa* as to these types.

STYLOGASTER ETHIOPA Townsend

Stylogaster ethiopa Townsend, Annals and Mag. Nat. Hist., ser. 6, vol. 19, 1897, p. 26.—Kröber, Entom. Mitteilungen, vol. 3, 1914, p. 351; Archiv Naturgesch., vol. 83, 1917 (1919), p. 43, pl. 8, fig. 54.

Stylogaster aethiops Szilady, Ann. Mus. Nat. Hung., vol. 24, 1928, p. 592, fig. 3.

Female.—Front rather wide, the ocellar triangle large, shining, brownish black, reaching almost to the lunule; the remainder of the front is opaque velvety black, except a narrow silvery orbit, an extension of the facial color which reaches fully to the middle of the front. Antennae rather short, second joint on outer side not much more than one-half the third and nearly black in color; third joint black with narrow reddish border below. Mesonotum rather shining uniform black, the humerous and a narrow space close to it pale yellow, the black of the dorsum extending down on the mesopleura, posterior part of mesonotum very slightly paler; humeral 1; notopleural 2; supraalar 2.

Abdomen quite dark, anterior third or half of each segment dark yellow except a median continuation of the black part. First segment black above, with only pale bristles on the sides, the area from which they arise being very faintly brownish. Ovipositor black, short basal segment yellow, base of second and third segments yellow, the combined length slightly more than the rest of the abdomen. Hind femora with two broad black ill-defined annuli; hind tibia with striking white color, beginning beyond the middle and reaching almost to the apex, the white portion has white hairs behind; hind tarsi entirely black.

Length, 5.5 mm. to ovipositor, the latter a little over 3 mm.

Redescribed from 9 female specimens: 3 were from Higuito, San Mateo, Costa Rica (Pablo Schild); 2 La Suiza de Turrialba, Costa Rica (P. Schild, received from Prof. A. L. Melander); 3 Lombardia, Honduras (W. M. Mann); 1 Cano Saddle, Gatun Lake, Canal Zone (R. C. Shannon).

Originally described from 20 female specimens, taken near San Rafael, Vera Cruz, Mexico. See note under *stylosa* as to these types.

STYLOGASTER ORNATIPES Kröber

Stylogaster ornatipes KRÖBER, Entom. Mitteilungen, vol. 3, 1914, p. 350; Archiv. Naturgesch., vol. 83, 1917 (1919), p. 43, pl. 8, fig. 58.

Male.—Frontal triangle very large, shining black, blunt anteriorly, almost touching the lunule, a faint light streak extending forward from the median ocellus; remainder of front velvety black, except a silvery marginal streak ascending from the face and rapidly narrowing to about the middle of the frontal orbit. First joint of antennae rather dark yellow; second brown; third blackish except on under side and near base, broader near base than in most of the species, a little more than twice the length of the second joint. Mesonotum shining black, the humerus white and with a narrow yellowish border behind and mesially. Scutellum blackish; hind edge of mesonotum brown. Metanotum black on middle, the usual brown stripe on the mesopleura extends to the pteropleura and sternopleura where it is somewhat lighter in color. There is also a brown spot in front of the base of the halteres. Humeral 1; notopleural 2; supraalar 2.

Abdomen blackish, with the usual lateral paler triangles on the third and fourth segments, very slightly developed on the fifth. First abdominal segment with dense pale bristles at the sides, arising from a slightly darker area; second segment with numerous, irregularly arranged, large white lateral bristles among which two or three of the upper are black; sixth segment wholly brown, longer and more conspicuous than usual; seventh segment also brown. Genitalia yellow, posterior forceps small and not distinctly visible, anterior forceps very wide with a row of conspicuous dark hairs on the hind edge, partly concealing the posterior forceps.

Front legs pale yellow, the coxae with a tuft of black hairs at tip on the front side and a few pale ones on the posterior side. Middle femora rather stout, somewhat brownish above; middle tibiae yellow, gradually enlarged and pale; beyond the middle on the flexor side, a very striking cluster of long black hairs extending far beyond the apex. Anteriorly this brush is united with a group of much shorter black hairs; middle tarsi yellow, the first joint enlarged on the dorsal side before the middle and bearing five or six black erect spines in a row; hind femora with the usual two dark annuli, the basal one being quite diffused and brownish. The usual villous hairs on the inner side at the lower edge are comparatively few in this species and form a single, or partly double, erect row of about uniform length, the trochanter being entirely bare and shining brown in color;

hind tibiae black except for a white annulus covering about the penultimate fifth; hind tarsi black.

Wing somewhat brownish, first posterior cell not wider than the submarginal; tip of second vein farther from base than anterior end of hind crossvein.

Length, about 7.5 mm. (the abdomen having been detached and glued on the mount, the length can not be positively given).

Redescribed from one male, Santos, Brazil, received from Doctor Kröber, under the name of *ethiopa* Townsend.

This might be a male of *speciosa*, except for the marked difference in the length of the third antennal joint, which does not seem to vary in the two sexes in any of the other species.

STYLOGASTER DECORATA, new species

Male.—Precisely like *ornatipes* in most of the characters, the only differences that I can make out being as follows: The third antennal joint is not only broad near base, somewhat bulging below, but continues rather wide to the apex; the second joint is a little shorter than in *ornatipes* so that the third is about three times its length; the dark pleural stripe extends upon the sternopleura, but not upon the pteropleura. The front coxae have ordinary short bristles at tip, the middle femur is less thickened, the middle tibia, although enlarged from the middle, is not so broad as in *ornatipes;* it has a cluster of black hairs on the flexor side beginning slightly before the middle and confined to a narrow space along that side; although striking, it is much less so than the corresponding tuft in *ornatipes.* The front side of the tibia also has a few unusually long hairs on the apical half, but they do not form a conspicuous tuft. The middle basitarsus is not enlarged, but has, beginning almost at the middle, a series of five small suberect setules. The bristles of the first and second abdominal segments are the same.

Wing: The first posterior cell distinctly narrower than submarginal.

Length, 6 mm.

Described from two males; the type from Higuito, San Mateo, Costa Rica; the other from La Suiza de Turrialba, Costa Rica, both collected by Pablo Schild, and the second received from Prof. A. L. Melander, to whom is is returned.

Type.—Male, Cat. No 43025, U.S.N.M.

STYLOGASTER CURRANI, new species

Male.—Frontal triangle very short, the shining portion extending in front of the median ocellus hardly more than the diameter of the latter. Entire front reddish brown, very little paler close to lunule, bordered on each side by a narrow, darker brown orbital stripe. Antennae brown, first joint and extreme base of second white, third joint slightly reddish below and around the tip, about

one and one-tenth times as long as second; mesonotum mostly blackish, but with an ill-defined paler median stripe which is usually quite conspicuous. Humeri white, the area on the mesial side light brown halfway to middle line and the same color extending back above the notopleura to the transverse suture; mesopleura dark brown, gradually lighter close to sternopleura; posterior part of mesonotum yellowish brown. Humeral 1; notoplural 2; supraalar 1. Scutellum blackish on the disk, the remainder brown. Metanotum black on median region, sharply defined, the sides yellow.

Abdomen blackish, the first segment black across the disk, whitish in front and behind and the lateral area entirely white, bearing a large tuft of spiny black bristles; second segment black, indistinctly paler in the middle, bearing a few outstanding black bristles on the sides at base; second and third segments with an opaque posterior black crossband including about one-third of the length, extending forward in the middle to the anterior edge to form a median stripe; fifth segment more extensively black, shining in certain directions with an indefinite brown area on the sides anteriorly; remaining segments light yellow without any distinct dark markings. The genitalia show a pair of erect compressed lobes side by side, rounded apically, and bearing black hairs behind almost to the tip.

Front and middle legs very pale yellow, tarsi gradually infuscated. Front coxae with numerous long black hairs at tip in front and behind. Hind femora black, extreme base and tip and a rather narrow annulus just before the middle white. Tibia pale for about three-fourths of the length, the remainder blackish; hind tarsi entirely black.

Wing uniformly infuscated, the costa with rather longer hairs than usual. Last section of fourth vein considerably bowed so that the first posterior cell is perceptibly wider than the submarginal. Tip of second vein decidedly farther from base of wing than anterior end of hind crossvein.

Female.—Front as in male; front coxae with much shorter and fewer black hairs at tip; hind coxae at extreme tip with a single row of rather striking but not very long black hairs. Ovipositor longer than remainder of abdomen, dark yellow at extreme base, then black, a pale yellow ring at the tip of the middle segment, the apex yellow.

Length, male 8 mm., female about 6.2 mm. to the ovipositor, which is 4 mm.

Described from seven males and three females collected on Barro Colorado Island, Canal Zone, by C. H. Curran. Type in American Museum of Natural History.

Paratype.—Male, Cat. No. 43026, U.S.N.M.

STYLOGASTER BANKSI, new species

Male.—Frontal triangle extending to middle of front, the latter blackish, a little reddish close to lunule. Antennae brown except first joint and extreme base of second; third joint blackish, the apex red below, about one and two-tenths times the length of the second. Mesonotum mostly black, which extends in a broad stripe down the mesopleura. Humerus white, adjacent parts brownish. Hind part of dorsum yellowish brown. Scutellum with a dark spot on disk and the extreme lateral corner black. Lower part of metanotum black in middle. Humeral 1; notopleural 1 (or 2 very close together); supraalar 1.

Abdomen largely black; first segment black above, lateral bristles numerous, black, arising from a distinctly brownish spot; second segment black except extreme base, with three or four black bristles at the side anteriorly; third and fourth segments with light yellow lateral triangles at base, which in the third reach nearly to hind margin at the side, in the fourth not so extended; fifth segment shining black except basally and along the sides below; sixth segment very narrow, blackish, shining; seventh segment blackish at sides, a conspicuous whitish spot occupying most of its surface and reaching front margin in middle. Genitalia rather pale, the posterior forceps strongly hooked and rather sharp at the tip, the anterior or outer forceps have a long process at tip which closes in repose so as to project on the opposite side for a considerable distance (this, of course, might be concealed in some specimens); the posterior forceps are rather far apart at base so as to inclose an oval space partly filled with pale hairs projecting from the forceps.

Front and middle legs pale yellow, the tarsi a little darker; hind femora yellow at base and tip and with a broad yellow median annulus; hind tibae pale at base, becoming black in middle, the penultimate fifth rather distinctly white, remainder and tarsi black. The erect pile of the inner side of the femur is rather sparse and only extends to about the middle.

Wing uniformly light brownish, the first posterior cell wider than the marginal; second vein decidedly shorter than usual, ending nearer base of wing than the anterior end of hind crossvein.

Female.—Ovipositor a little longer than remainder of abdomen, yellow at base, the remainder black, extreme tip and its appendages yellow.

Length, male 6.3 mm., female 5.5 mm. to ovipositor, which measures 3.9 mm.

Described from 16 males and 10 females, all collected at Barro Colorado Island, Canal Zone, one male by Nathan Banks, the remainder by C. H. Curran.

Type in American Museum of Natural History.
Paratype.—Male, Cat. No. 43027, U.S.N.M.

STYLOGASTER BREVIVENTRIS, new species

Male.—Frontal triangle of medium size, brownish, shining, the sharp apex slightly exceeding middle of front; front black above, becoming yellow on the lower third or fourth; first antennal joint whitish, second whitish at base, remainder yellow; third joint yellow with infuscated upper edge, of the same length as the second; proboscis yellow to the middle of the first joint. Mesonotum shining brownish black, the humeri white and the same color extending back to the suture and mesially for a little distance; pleural stripe much paler than usual, indistinct except above, the posterior opaque brown area of the mesonotum rather large. Scutellum brown, metanotum blackish in middle; humeral 1; notopleural 2; supraalar 1.

Abdomen considerably wider and shorter than usual. First segment mostly yellow, only a brownish shade extending across near the hind edge and a small dark spot in middle, the lateral bristles black, numerous, and arising from a pale spot; the second segment more widened at apex, pale at base, then brown, a darker brown line bordered with a row of large hairs extending across at about three-fourths the length, the remainder bare and slightly paler; lateral bristles black, few, and large; third segment shorter and a little wider than second, with a brown somewhat arcuate band across the middle, bordered by a row of large hairs, the space behind this being bare; this arcuate band approaches the hind margin at the sides; fourth segment as wide as the third but a little shorter, mostly dark brown, having like the preceding two segments, a noticeable bare area behind; fifth segment fully as long as the two preceding segments taken together, brown except along the sides; it has at the posterior edge a peculiar somewhat globose area in the middle which widens forward in the form of two ridges extending toward the sides and including at the front edge almost the whole width of the segment; sixth segment short, blackish; seventh segment also blackish. Viewed from the side, the shining brown fifth segment is large and conspicuous and is longer than the two preceding.

Front and middle legs pale yellow; front coxae with only a few small dark hairs at tip: hind femora brown with a broad pale annulus in the middle, very few villous hairs on the inner side near base; hind tibiae yellow on basal half, slightly brownish beyond, with faint indications of a pale annulus before tip; flexor side with minute, erect hairs beyond middle; hind tarsi brown, blackish at tip. Hind trochanters without usual pile.

Wing slightly brown, first posterior cell as wide as submarginal; second vein shorter than usual, the tip nearer the base than anterior end of hind crossvein.

Female.—Abdominal segments two and three as in the male; fourth segment brown, almost as wide as third and a little longer, its apical half or more bare, of soft appearance and corrugated lengthwise; this peculiar area is wider in the middle than at the sides. Fifth segment rapidly narrowing, dark brown in color. Ovipositor longer than remainder of the abdomen, its short basal segment dark yellow, principal segment black, terminal segment dark brown, yellow at base and tip.

Length, male 5 mm., female 3.7 mm. to ovipositor, which is 2 mm.

Described from six males and three females, Kartabo, British Guiana, received from Canadian National Collection, to which the type is returned.

Paratype.—Male, Cat. No. 43028, U.S.N.M.

STYLOGASTER FASCIATA, new species

Male.—Front not quite so wide as in *stylata*, the frontal triangle brown, extending to the middle of the front, where it is not very sharply defined; remainder of front brown except silvery orbits ascending from the face for a short distance. Second antennal joint brown, third reddish but broadly brown above and at tip, almost three times the length of the second. Dorsum of thorax black, a broad brown stripe extending from notopleural suture down across mesopleura and sternopleura, including all the lower part of the latter. Humeri pale yellow, hind part of mesonotum brownish yellow. Scutellum brown, its sides more yellowish. Metanotum with a distinct black spot not as wide as the first abdominal segment. Humeral 1; notopleural 1; supraalar 2.

Abdomen dark brown, the first segment white at the sides with only white lateral bristles; second segment with a very narrow white pollinose basal crossband and only white lateral bristles; third, fourth, and fifth segments with white pollinose basal crossbands occupying about one-third of the segment; pale hairs on sides of fifth conspicuous; seventh segment dark yellow. Front coxae with inconspicuous mixed light and dark hairs at tip.

Front and middle legs pale yellow, tarsi a little darker toward tip. Hind femora with two wide blackish annuli and without any erect pile on the inner side, hind trochanters bare. Hind tibiae yellow at base, dark brown in the middle, then slightly enlarged and white nearly to tip, the extreme tip being black; there are no villous hairs on the tibiae; hind tarsi entirely black.

Wings slightly infuscated, first posterior cell a little wider in the middle than the submarginal cell just before it. The second vein

longer than usual, the costal segment between its apex and that of the third vein about as long as the hind crossvein.

Length, 8.2 mm.

The proboscis in this specimen extends directly forward and has a length of 9 mm.

Described from one male, collected at Bartica, British Guiana, and received from C. W. Johnson. Type in Museum of Comparative Zoölogy.

STYLOGASTER APICALIS, new species

Male.— Frontal triangle rather large, extending somewhat more than halfway to the lunule; front brown from the lunule upward, almost black at vertex. Antennae pale at base, third joint red with dark upper border and more widely around apex. Mesonotum black, humeri white, a broad brown stripe extending down the mesopleura, ending at the sternopleura. Humeral 1; notopleural 2; supraalar 1.

Abdomen mostly blackish, first segment dark above except extreme base, the lateral bristles black and arising from a brown or blackish spot; second segment with basal fourth yellowish, which becomes wider at the sides, lateral bristles black, in a single row; third, fourth, and fifth segments mostly black with basal yellow band narrowed in middle.

Front and middle legs yellow, the tarsi slightly brownish apically; hind femora brown, the middle third a little lighter. Villous pile of coxae, trochanters, and inner sides of femora almost entirely absent. Hind tibiae brownish, the penultimate fifth a little paler; hind tarsi entirely black.

Wing slightly brownish, first posterior cell beyond its middle about equalling in width the submarginal; last section of fifth vein equal to one-half the hind crossvein. Tip of second vein nearer base than anterior end of hind crossvein.

Female.—Ovipositor slightly longer than the remainder of the abdomen, short basal segment yellow, second black, the apical segment white except on basal third, the tip becoming brown and the appendages yellow.

Length, male 4.8 mm., female 4 mm. to ovipositor, which is 2.3 mm.

Described from 5 specimens: 2 males, including the type, from Lombardia, Honduras (W. M. Mann); 2 females Barro Colorado Island, Canal Zone (C. H. Curran); the fifth is also from Lomardia, Honduras (W. M. Mann), but has lost the abdomen and the sex is uncertain.

Type.—Male, Cat. No. 43029, U.S.N.M.

STYLOGASTER SPECIOSA, new species

Female.—Frontal triangle large, shining black, almost reaching lunule, slightly blunt at tip, often with a distinct light streak in front of the anterior ocellus; remainder of front velvet black to the lunule except a rather wide silvery orbital stripe which extends from the face and disappears before the vertex. First and second antennal joints yellow, the latter slightly brown above; third joint reddish with the upper edge blackened to the arista, which is almost at the apex; third joint about one and four-tenths times the second. Mesonotum mostly shining black; the humerus white, but the black color approaches close to it behind and on the mesial side; the usual dark stripe on the mesopleura disappearing at the beginning of the sternoplura. Hind edge of the thorax dark brown. Scutellum blackish. Metanotum distinctly black on its middle portion. Humeral 1; notopleural 2; supraalar 2.

Abdomen largely black, the sides of segments 2 to 5 yellow except posteriorly, the color forming an interrupted crossband, more widely interrupted on the fifth, less so on the fourth; first segment with only white bristles on the sides, but in most of the specimens they arise from a spot which is distinctly darker making a somewhat unusual combination; second segment with a row of large lateral black bristles also on a dark spot, the lower one or two bristles may be pale. Ovipositor somewhat longer than the remainder of the abdomen, the basal short segment yellow, principal segment black except extreme base. Last joint snow white for half its length, gradually darkening so that the apical third is shining black; appendages also black and with black hair.

Front and middle legs pale yellow, tarsi darker beyond the first joint. Hind femora pale yellow with comparatively narrow blackish annuli. Hind tibia black for a little more than half its length, then pure white with white hair, the apical sixth black together with the hind tarsi.

Wing slightly brownish, first posterior cell not wider than submarginal. Tip of second vein farther from base than anterior end of small crossvein.

Length, 6 mm. to ovipositor, the latter 4.2 mm.

Described from seven females, collected on Barro Colorado Island, Canal Zone (five by C. H. Curran and two by Nathan Banks).

Type in American Museum of Natural History.

Paratype.—Female, Cat. No. 43030, U.S.N.M.

STYLOGASTER PECTINATA, new species

Male.—Front rather narrow, uniform brown to the lunule, hardly darker above, the shining brownish triangle reaching middle.

Antennae rather short, first joint white, the other two brown, the third reddish below, as long as second. Proboscis yellow to middle of basal joint. Mesonotum brownish black, the color reaching the white humerus behind and mesially. Mesopleura brown to sternopleura. Posterior part of mesonotum opaque dark brown. Scutellum and middle of metanotum brown. Humeral 1; notopleural 1; supraalar 1.

Abdomen dark brown, first segment with rather numerous black lateral bristles arising from a white area; second segment whitish on basal fifth, yellow along sides with a few large black lateral bristles in a single row; third and fourth segments with narrow basal yellow band wider at sides; fifth segment brown, narrowly yellow at base and with yellow sides; sixth segment narrow, blackish; seventh segment blackish. Genitalia yellow, last sternite not excavated posteriorly, with a distinct median groove basally, the hind margin with comb of fine black setules and before these two separated small dark spots bearing minute black hairs.

Front and middle legs yellow, not very pale; hind femora brown with median paler area not very conspicuous, inner and lower sides of femora with long hairs on basal half; hind tibia light brown with numerous erect fine hairs on flexor side from middle; hind tarsi brown.

Wing slightly brownish, the first posterior cell barely wider than submarginal, hind cross vein almost continuous with last section of fourth vein, which is nearly straight. Tip of second vein nearer to base than anterior end of hind crossvein.

Length, 5.2 mm.

Described from two males. The type is from Lombardia, Honduras (W. M. Mann); the other male is from Laristal, Peru, received from Dr. O. Kröber.

Type.—Male, Cat. No. 43031, U.S.N.M.

STYLOGASTER RECTINERVIS, new species

Male.—Frontal triangle rather large, shining brown, hardly reaching beyond middle of front; front dark reddish brown, almost uniform to lunule, the lateral orbital extensions of the facial color hardly perceptible; first antennal joint whitish, second and third dark yellow, third brown at tip and just equalling length of second. Proboscis yellow to middle of basal joint. Mesonotum brownish, not so dark as in most species, the dark color, however, comes close to the humerus behind and on the inner side. Mesonotum with only a trace of dark, the dark color is interrupted across the transverse suture and behind that is principally confined to three spots with lighter margins. Scutellum and middle of metanotum dark brown. Humeral 1; notopleural 2; supraalar 1.

Abdomen dark brown, second to fourth segments with a yellow triangle on each side reaching the hind margin laterally; first segment distinctly white at the sides, with stout black bristles, second segment with a single row of erect, black bristles; fifth segment mostly brown; sixth segment very narrow, blackish; seventh also blackish. Genitalia pale yellow, the posterior forceps of soft appearance, strongly hooked at the anterior end.

Front and middle legs pale yellow, the tarsi only a little darker; hind femora yellow with two rather narrow and distinct dark annuli, the erect pile on the inner and lower surface is longer than in any of the other species but extends only to the middle of the femur; basal third of the femur strongly shining; hind tibia brown with a whitish ring on penultimate fifth, not very striking, its flexor side with numerous, short, erect hairs on the apical half; hind tarsi brown.

Wing brownish, first posterior cell wider than submarginal; second vein short, tip nearer the base than the anterior end of the hind cross vein. Petiole of first posterior cell joining costa almost exactly at the tip of the wing, the last section of the fourth vein being nearly straight.

Female.—Ovipositor about as long as remainder of abdomen; black, yellow at incisures and apex; the short basal segment yellow. Hind femora not shining and hind tibiae brownish without annulus.

Length, male 5 mm., female 4 mm. to ovipositor, which is 2 mm.

Described from two males and one female; one male and the female are from Kartabo, British Guiana (received from Canadian National Collection), the other male, which is headless, is from La Suiza de Turrialba, Costa Rica (Pablo Schild, received from Prof. A. L. Melander). In this specimen the femora are not shining on the basal third; the male from Kartabo is taken as the type and the other specimens show slight differences which in more material might possibly prove specific. The type is returned to the Canadian National Collection.

Allotype.—Female, Cat. No. 43032, U. S. N. M.

STYLOGASTER INDISTINCTA, new species

Male.—Frontal triangle very large, occupying almost the entire front, its apex broadly touching the lunule and leaving only a narrow strip on each side which is dark brown, together with a slight extension of the silver of the face on the lower part of frontal orbit. First antennal joint white, second and third brownish yellow, the latter more red below and about two and two-tenths times the second. Proboscis black to the extreme base. Mesonotum dark brown above with indications of two lighter submedian stripes, the dark color almost joins the humerus behind and on the mesial side,

the dark pleural band extends to the middle coxae. Hind part of mesonotum brownish yellow. Scutellum not very dark brown, the dark color of the mesonotum limited to a triangle below the scutellum.

Abdomen mostly black, not in very good condition in the single specimen, the lateral bristles of the first segment are all pale and arise from a pale area; the second segment shows an unusual character in having the lateral bristles extending all the way along the sides instead of being limited to a small area near the front of the segment.

Front and middle legs pale yellow, the hind femora yellow with two ill-defined dark annuli; hind tibiae dark yellow except the apical fifth, which is brown. Hind tarsi brown. Hind trochanters bare and femora without noticeable pile on the inner side.

Wing a little brownish; hind cross vein more erect than usual, its anterior end almost exactly at the same distance from the base of the wing as is the tip of the second vein, which is, however, nearer the base than usual.

Length, 3.8 mm.

Described from one male, Cano Saddle, Gatun Lake, Canal Zone (R. C. Shannon).

Type.—Male, Cat. No. 43033, U.S.N.M.

STYLOGASTER PERUVIANA, new species

Female.—Frontal triangle large, shining black, brown anteriorly, its blunt apex just touching the lunule; the silver of the face extends up the orbits to an unusual extent, comprising almost half the front outside the triangle, the intervening space being velvet black; first antennal joint dark yellow, second brown, third broadly reddish below, about one and four-tenth times the second. Mesonotum shining brownish black, the white humeri only slightly bordered with brownish yellow behind and mesially; posterior edge of mesonotum dark brown. Mesopleura with a wide but rather short brown stripe. Scutellum dark brown on disk, elsewhere light brown. Metanotum with a triangular bulging portion black. Humeral 1; notopleural 2; supraalar 2.

Abdomen mostly shining brownish black; first abdominal segment with black bristles laterally, arising from a brownish spot; second segment with irregularly arranged lateral bristles of decreasing size, becoming hairlike only at the hind edge; second to fifth segments with lateral triangles of yellow, which are successively smaller and more widely separated at the middle. Ovipositor as long as the remainder of abdomen, its narrow basal joint yellow, the following two of almost equal length, narrowly yellowish at base, tip of last segment and the median process yellow.

Front and middle legs rather pale yellow; hind femora with the usual two dark annuli, base and tip distinctly yellow; hind tibiae yellow at base, becoming blackish at middle, penultimate fifth distinctly whitish but with almost entirely black hair; hind tarsi black.

Wing almost hyaline, last section of fourth vein considerably curved, but the first posterior cell not perceptibly wider than the submarginal; tip of second vein slightly farther from base than anterior end of hind crossvein.

Length, 6.5 mm. to ovipositor, which is 4.5 mm.

Described from one female, Laristal, Peru, received from Dr. O. Kröber.

Type.—Female, Cat. No. 43034, U.S.N.M.

STYLOGASTER PANAMENSIS, new species

Female.—Head and thorax as in *peruviana*, including chaetotaxy.

Abdomen considerably darker; first segment wholly blackish above except at base, the lateral bristles all white and arising from pale ground color; second segment dark brown, very obscurely yellow at base, the lateral bristles as in *peruviana*, but the ground color is dark to the lateral margin except in front of the main row of bristles; third, fourth, and fifth segments with rather indistinct and obscure yellow lateral markings. Ovipositor longer than remainder of abdomen, its short basal segment and the base of each of the following ones yellow, the rest dark brown including apex.

Legs as in *peruviana*, but the hind tibiae almost uniformly dark yellow with only a slight trace of a median dark ring and a more distinct apical infuscation.

Wing rather indistinctly brownish, last section of fourth vein not very broadly curved, toward apex quite straight; first posterior cell distinctly narrower than submarginal; hind crossvein rather erect, tip of second vein farther from base than anterior end of hind crossvein.

Length, about 4 mm. to ovipositor, which is 2.5 mm.

Described from two females, Barro Colorado Island, Canal Zone (N. Banks); type in Museum of Comparative Zoölogy.

Paratype.—Female, Cat. No. 43035, U.S.N.M.

STYLOGASTER ABDOMINALIS Kröber

Stylogaster abdominalis Kröber, Entom. Mitteilungen, vol. 3, 1914, p. 352.

Female.—Front and vertex deep velvet black to lunule. Antennae dark yellowish brown; first joint nearly square; second darker apically, above almost black-brown; third about one and one-half times the second, gradually narrowed, with a black-brown spot near

tip above. Mesonotum black, strongly shining, with depressed black hair; pleura with usual dark stripe. Metanotum opaque black in middle. Abdomen shining; first segment reddish brown above, its lateral bristles entirely white; second, third, and basal half of fourth segments wholly reddish yellow; remainder black except basal third of fifth. First long joint of ovipositor shining black, its base and the short basal joint reddish yellow with white pruinosity; terminal joint opaque black, white at base. Front and middle legs pale yellow; hind femora biannulate; hind tibiae blackish brown, before the tip with a whitish ring which bears yellowish-white hair. Wings grayish.

Length, 10.5 mm.

One female, Mapiri Sarampioni, Bolivia. Type in Dresden Museum.

I have not seen this species, but have given the more important characters from Kröber's description. The pale abdomen seems very unusual, and will probably suffice to distinguish the species.

STYLOGASTER BIANNULATA var. ARGENTINA Kröber

Stylogaster biannulata var. *argentina* KRÖBER, Konowia, vol. 8, 1929, p. 174.

Front above and vertex deep velvet black; pleura with broad, brown diagonal stripe; halteres wholly yellow. First abdominal segment black, somewhat yellowish only at the sides; second to fifth segments pale yellowish brown with black posterior crossband, which is drawn out forward in the middle, reaching anterior margin on second and fifth; sixth clear reddish yellow with two black spots on hind edge; seventh entirely yellow. Lateral bristles of second segment unusually long, black. Middle and hind coxae with white hair.

Length, 8 mm.

One male from Tapikiole, Northern Argentina.

(Translation of Kröber.)

I make this out to be a specimen of *stylata* with the abdomen slightly lighter in color than the ones I describe. Only an examination of the type to determine the other characters I am using will settle its status.

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A REVISION OF THE NORTH AMERICAN TACHINID FLIES OF THE GENUS ACHAETONEURA

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The identification of certain species belonging to the genus *Achaetoneura* is extremely difficult and, in some cases, unless the specimen to be identified is accompanied by its puparium or host record, a positive determination is apparently next to impossible. Moreover, the species which compose the genus are very variable and, in two cases at least, are of a complex nature. Naturally, many variants are present, and it is believed that recognition of such forms as species has caused the confusion which exists throughout the group. This conclusion has been arrived at from the study of a large number of bred specimens at the Gipsy Moth Laboratory, the results of studies conducted by J. V. Schaffner, jr., and C. L. Griswold, and from material at the United States National Museum.

Since the species discussed are extremely liable to misidentification and because of the impracticability of their verification, previously published records as regards host and distribution have been, in most part, omitted from this revision. In another paper now in manuscript, this subject, particularly the host relations, will be fully considered.

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Genus ACHAETONEURA Brauer and Bergenstamm

Achaetoneura Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, vol. 5, p. 334, 1891.

Parafrontina Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, vol. 6, p. 115, 1893.

Rileyella Townsend, Ann. Ent. Soc. Amer., vol. 2, p. 249, 1909.

Ypophaemyia Townsend, Ins. Ins. Mens., vol. 4, nos. 7–9, p. 75, 1916.

Masiceropis Townsend, Ent. News, vol. 27, no. 4, p. 178, 1916.

Brauer and Bergenstamm erected *Achaetoneura* for *hesperus*, new, but added several other species without distinctly designating one as type of the genus. Coquillett [1] designated *hesperus* as type. In his Revision of the North American Tachinidae (p. 105, 1897), Coquillett had included the North American species in *Frontina*, indicating as synonyms *Achaetoneura*, *Thysanomyia*, and *Parafrontina* of Brauer and Bergenstamm, and *Prosopaea* Rondani. In 1910, however (p. 545), he omitted *Thysanomyia* and *Prosopaea* from the synonymy of *Frontina*.

The type species of *Frontina* is *Tachina laeta* Meigen, by designation of Robineau-Desvoidy. This European species has strong discal bristles on the intermediate abdominal segments, the hind tibiae irregularly bristled, the third antennal joint peculiarly slender, and other characters foreign to *Achaetoneura*. Moreover, as Allen [2] has pointed out, *laeta* deposits microtype eggs on foilage, a reproductive habit distinctly different from that of *Achaetoneura*.

The conclusion accepted in the present paper is that *Frontina* in the proper sense does not occur in North America and that *Achaetoneura* is the oldest valid name to include our species. Except *Parafrontina*, the synonyms listed above are of more recent date than Coquillett's work.

Parafrontina, according to Townsend,[3] has the eyes thickly pilose and could be excluded on this account; but there is evidently a mistake here, as the examination of the type series of the genotypic species *Parafrontina apicalis* Brauer and Bergenstamm shows the eyes to be bare. The species is exceedingly close to *Achaetoneura archippivora* Williston, and the genus is undoubtedly synonymous with *Achaetoneura*. *Rileyella* [4] was proposed by Townsend for the reception of *Frontina aletiae* Riley,[5] the sole character of the genus being the absence of median macrochaetae on the first and second abdominal segments above, either discal or marginal. This character alone can scarcely be considered of generic importance in this group any more than can the extremely variable characters which differentiate *Ypophaemyia* Townsend,[6] type *malacosomae* Townsend, from *Achaetoneura*. According to Townsend,[7] *Masiceropsis* differs from *Ypophaemyia* by broader front, longer antennae in female, no well-developed marcrochaetae on first abdominal segment, apical cross-vein approximate to hind border of wing, hind cross vein farther from bend of fourth vein, and anal segment without

[1] Proc. U. S. Nat. Mus., vol. 37, p. 502, 1910.
[2] Trans. Amer. Ent. Soc., vol. 52, p. 187, 1926.
[3] Bull. Amer. Mus. Nat. Hist., vol. 37, p. 232, 1917.
[4] Ann. Ent. Soc. Amer., vol. 2, p. 249, 1909.
[5] Canad. Ent., vol. 11, p. 162, 1879.
[6] Ins. Ins. Mens., vol. 4, nos. 7–9, p. 75, 1916.
[7] Idem, p. 76, 1916.

true discals, but with only submarginal or subdiscal macrochaetae. The type of *Masiceropsis* is *Masicera pauciseta* Coquillett, the type specimen of which is a female from California, a small fly with shrunken third antennal joint, parallel scutellar bristles, and weakly ciliated hind tibiae. It is accompanied by two males from the same locality (Los Angeles County) and all are undoubtedly the same species. This material, while not identical, is certainly inseparable generically from the *archippivora* complex on any stable characters.

The genera *Eucelatoria*, *Pseudomyothyria*, *Frontiniella*, *Ptychomyia*, *Prosopalaea*, and *Azygobothria* are all closely allied to *Achaetoneura* but distinct from that genus as here circumscribed.

Characters of Achaetoneura.—Eyes bare, at most with slight pubescence; facialia bristly at least one-half way; ocellar bristles present and directed forward, approximate at base and not especially divaricate; antennae reaching lowest fourth of face; third joint broad, rounded at apex, never tapering to a point; second joint usually short, sometimes elongate; frontal bristles extending below base of third antennal joint; front without evenly paired reclinate bristles outside of frontal row midway between lowest ocellus and base of antennae; arista bare; parafacials bare; face slightly receding; vibrassae at oral margin; bucca bristly; palpi yellow, well developed; proboscis short and fleshy. Thorax with well-developed bristles; four postsutural dorsocentrals, four sternopleurals; pteropleural bristle small; apical scutellar bristles present, usually erect and cruciate; abdomen pollinose, never with ventral carina, sharp piercer, or true discal macrochaetae; median marginal bristles present or absent on first and second segment. Hind tibiae evenly ciliate, with or without a longer bristle. Wing with normal venation, first posterior cell open, ending considerably before apex of wing; last section of fifth vein never one-half as long as preceding; veins bare excepting base of third.

Method of reproduction.—Practically all of the species deposit maggots which are ready to hatch, in choria on the body of the host, although, according to Allen,[8] *aletiae* has developed the habit of subcutaneous larviposition.

Type of puparium.—So far as known, all of the species have smooth puparia, without spinelike hairs, and with the spiracular slits serpentine.

LIST OF HOST SPECIES

In citing the following host species, mention is made of only those whose record has been reviewed and the bred specimen examined.

[8] Trans. Amer. Ent. Soc., vol. 52, p. 188, 1926.

Undoubtedly many of the other published records of host species are correctly referred to, but verification of them has not been obtained.

Achaetoneura frenchii (Williston).—*Callosamia promethea* Drury; *Ceratomia catalpae* Boisduval; *C. undulosa* Walker; *Datana anguisii* Grote and Robinson; *D. ministra* Drury; *D. integerrima* Grote and Robinson; *Diacrisia virginica* Fabricius; *Hyphantria cunea* Drury; *Malacosoma americana* Fabricius; *M. disstria* Hübner; *Nygmia phaeorrhoea* Donovan; *Paonias myops* Smith and Abbot; *Papilio polyxenes* Linnaeus; *P. troilus* Linnaeus; *P. turnus* Linnaeus; *Philosamia cynthia* Drury; *Pontia rapae* Linnaeus; *Porthetria dispar* Linnaeus; *Samia cecropia* Linnaeus; *Smerinthus geminatus* Say; *Sphinx chersis* Hübner; *S. kalmiae* Smith and Abbot; *Telea polyphemus* Drury; *Tropaea luna* Linnaeus; *Vanessa atalanta* Linnaeus.

Achaetoneura euchaetiae, new species.—*Euchaetias egle* Drury; *Halisidota tessellaris* Smith and Abbot.

Achaetoneura anisotae, new species.—*Anisota senatoria* Smith and Abbot; *A. rubicunda* Fabricius; *Diacrisia virginica* Fabricius.

Achaetoneura samiae, new species.—*Samia cecropia* Linnaeus; *Malacosoma americana* Fabricius.

Achaetoneura melalophae (Allen).—*Melalopha inclusa* Hübner.

Achaetoneura cuculliae, new species.—*Cucullia* sp.; *Dasylophia anguina* Smith and Abbot.

Achaetoneura dimmocki, new species.—(*Hyperchira*) *Automeris io* Fabricius.

Achaetoneura archippivora (Williston).—*Aglais milberti* Godart; *Alypia octomaculata* Fabricius; *Anosia plexippus* Linnaeus; *Euchaetias egle* Drury; *Euvanessa antiopa* Linnaeus; *Halisidota caryae* Harris; *Malacosoma americana* Fabricius; *Pontia rapae* Linnaeus; *Vanessa atalanta* Linnaeus.

Achaetoneura spectabilis (Aldrich).—*Tetralopha robustella* Zeller.

Achaetoneura testacea, new species.—*Pholus vitis* Linnaeus.

Achaetoneura aletiae (Riley).—*Alabama argillacea* Hübner; an arctiid; *Epargyreus tityrus* Fabricus; *Euvanessa antiopa* Linnaeus; *Halisdota tessellaris* Smith and Abbot; *Hemerocampa leucostigma* Smith and Abbot; *Hemileuca maia* Drury; *Hyphantria cunea* Drury; *Pholus* sp.; *Porthetria dispar* Linnaeus; *Stilpnotia salicis* Linnaeus.

Achaetoneura schizurae (Townsend).—*Schizura unicornis* Smith and Abbot.

Achaetoneura piperi (Townsend).—*Schizura ipomoeae* Doubleday.

Achaetoneura rileyi (Williston).—*Papilo thoas* Linnaeus.

Achaetoneura laniiferae, new species.—*Laniifera cyclades* Druce.

Achaetoneura pholi, new species.—*Pholus* species.

TABLE OF SPECIES

1. First two segments of abdomen bearing median marginal bristles, those of the first segment often weak and hairlike but rarely absent ..... 2.
— First, or first and second segments of abdomen destitute of median marginal bristles ..... 14.
2. Front at vertex in both sexes about equal to or less than eye width; arista thickened at base and tapering to apex; front pulvilli of male usually as long as or longer than last tarsal joint ..... 6.
— Front at vertex in both sexes well over the eye width ..... 3.
3. Front at vertex less than one and one-half times the eye width; one row of bristles ascending the facial ridges ..... 4.
— Front at vertex nearly twice the eye width; two irregular rows of bristles ascending the facial ridges ..... 10. **westonia**, new species.

4. Front, face, and post-orbital region cinereous, the former sometimes with golden tinge; bucca one-fifth the eye height_____5.
— Front, face, and post-orbital region golden pollinose; frontal vitta about one-fourth the frontal width; bucca one-eighth the eye height.
9. **texana**, new species.
5. Arista thickened from one-half to three-fourths way; front pulvilli of male less than length of last tarsal joint; abdomen black, usually thick gray pollinose with anal segment concolorous or golden pollinose; marginal bristles of second abdominal segment often weak.
8. **archippivora** (Williston).
— Arista thickened at base and gradually tapering to apex; front pulvilli of male longer than last tarsal joint; abdomen black, thinly gray pollinose, anal segment never golden; marginal bristles of second abdominal segment well developed_____4. **samiae**, new species.
6. Hind tibiae evenly ciliate with one longer bristle_____7.
— Hind tibiae evenly ciliate without a longer bristle; abdomen yellowish, thinly gray pollinose, median vitta absent or at most poorly defined.
17. **laniiferae**, new species.
7. Thorax and abdomen black, gray pollinose, the latter without a median vitta_____9.
— Thorax and abdomen or the abdomen alone otherwise colored_____8.
8. Abdomen brown or yellowish with a clearly defined median vitta; front pulvilli of male short_____18. **ferruginea** (Reinhardt).
— Head and body entirely golden pollinose; abdomen without clearly defined vitta; front pulvilli of male long_____19. **spectabilis** (Aldrich).
9. Mid-tibiae with one strong bristle on the outer front side near middle or with one strong and one weaker one above it, rarely with two equally strong and a weaker bristle above them, but if so, then the abdominal hairs are sub-erect at most_____10.
— Mid tibiae with three strong bristles on the outer front side near middle, if with only two strong and a weaker one above them, then a portion of the abdominal hairs along the dorsum are erect; forceps of male genitalia (viewed from behind) at widest part over one-fourth their length; front with several strong bristles outside of the frontal rows which are equal in strength to the latter_____7. **dimmocki**, new species.
10. Robust forms from 8-12 mm. in length; front in male usually over one-fourth head width_____11.
— Uniformly slender flies 5–8 mm. in length; front and face deeply golden pollinose; front narrow, in male about one-fourth and in female less than one-third head width; abdomen black, moderately yellowish gray pollinose_____5. **melalophae** Allen.
11. Front of male and usually that of female destitute of any strong bristles outside of the frontal rows; posterior spiracles of puparium not in a depression_____12.
— Front in both sexes with several strong bristles outside of the frontal rows; forceps of male genitalia viewed from behind, at widest part, more than one-third their length; front tarsi of female not noticeably enlarged; posterior spiracles or puparium in slight but well defined depression (if in male the front pulvilli are short, see *archippivora*).
4. **samiae**, new species.
12. Forceps viewed from behind, at their widest part, at least one-third their length; front tarsi of female not noticeably thickened_____13.

— Forceps viewed from behind, at their widest part, scarcely one-fourth their length; front tarsi of female noticeably thickened; posterior spiracles of puparium situated on longitudinal axis----3. **anisotae**, new species.

13. Inner forceps of male genitalia, when viewed in profile, nearly straight or, at most, slightly bowed on their outer side, variable in length, form, and pigmentation; outer forceps slender. Sides of front in male moderately hairy, not thickly beset with minute hairs; posterior spiracles of puparium situated on longitudinal axis.

1. **frenchii** (Williston and complex.

— Inner forceps of male genitalia, when viewed in profile, distinctly bowed or straight for one-half their length and then inclined forward; outer forceps stout. Sides of front in male densely beset with minute black hairs; posterior spiracles of puparium situated above the longitudinal axis----2. **euchaetiae**, new species.

14. First two segments of abdomen destitute of marginal bristles----15.

— First segment of abdomen without, second segment with, marginal bristles----19.

15. Hind tibiae evenly ciliate with one longer bristle----17.

— Hind tibiae evenly ciliate without a longer bristle----16.

16. Inner eye margins but slightly diverging below; face and front cinereous; abdomen brown or yellowish with a well-defined dorsal vitta.

16. **rileyi** (Williston).

— Inner eye margins widely diverging below; front and face golden pollinose; abdomen yellowish, thinly gray pollinose, without clearly defined vitta----17. **laniiferae**, new species.

17. Head, thorax, and abdomen densely covered with golden pollen.

19. **spectabilis** (Aldrich).

— Head, thorax, and abdomen black, grayish pollinose, at most with sides of second and third segments reddish----18.

18. Third antennal joint in both sexes at least three times the length of second; eyes distinctly pubescent under high magnification (if eyes are bare, front at widest part over eye width, see *archippivora* or *schizurae*) ----12. **aletiae** (Riley).

— Third antennal joint in both sexes scarcely twice the length of second; eyes completely bare----6. **cuculliae**, new species.

19. Hind tibiae evenly ciliate with one longer bristle----22.

— Hind tibiae evenly ciliate without a longer bristle----20.

20. Abdomen black, gray pollinose; third antennal joint in both sexes at least three times the second----21.

— Abdomen brown or yellowish with a well-defined median vitta; third antennal joint in both sexes hardly twice the second; marginal bristles of the second abdominal segment weak or vestigial.

16. **rileyi** (Williston).

21. Median marginal bristles of second abdominal segment strong; hind tibiae densely ciliated; large form, 10–12 mm. in length.

15. **piperi** (Townsend).

— Median marginal bristles of second abdominal segment weak but constant in their appearance; hind tibiae moderately ciliated; medium sized forms 8–9 mm. in length. Thorax thickly gray pollinose with yellowish tinge (particularly noticeable when a series of specimens is observed); facial ridges usually bristly one-half way to antennae, sometimes a little less; front and face cinereous, the former with slight yellowish tinge, especially in female. This species is exceedingly close to *aletiae* but differs from

it in that the thorax is much more thickly gray pollinose, front and face never golden; abdomen black, lightly gray pollinose without brownish sides and bearing weak marginal bristles on second segment. Also the marginal bristles of the third segment are as long as or longer than are those of the fourth. If third antennal joint in either sex is less than three times second, see *cuculliae*_____13. **pholi**, new species.

22. Abdomen black, grayish pollinose_____24.
— Abdomen brown or golden pollinose_____23.
23. Head, thorax, and abdomen densely covered with golden pollen.
19. **spectabilis** (Aldrich).
— Head and thorax black, grayish pollinose, abdomen brownish, destitute of golden pollen_____11. **testacea**, new species.
24. Third antennal joint, in either sex, three or more times the second_____25.
— Third antennal joint scarcely twice the second; bucca one-eighth the eye height; small species measuring 6–8 mm. in length.
6. **cuculliae**, new species.
25. Front at vertex in both sexes about or less than eye width; arista thickened at base and tapering to apex; front pulvilli of male at least as long as last tarsal joint_____26.
— Front at vertex in both sexes well over the eye width; arista thickened from one-half to three-fourths way; front pulvilli of male less than length of last tarsal joint; abdomen usually thick gray pollinose.
8. **archippivora** (Williston).
26. Large robust species, 10–12 mm. in length; hind tibiae of male densely ciliated without a longer bristle (in female, one longer bristle); fourth abdominal segment densely bristly except at extreme base, bristles nearest apex strongest; genitalia of male light brown or yellowish in most part, forceps when viewed from behind, at widest part, over one-half as wide as long and bearing at base of inner ones a conspicuous tuft of hairs; front of male moderately prominent, projecting a little over one-half eye width; facialia strongly bristly a little over one-half way; front pulvilli of male smoky black, nearly as long as the last two tarsal joints_____15. **piperi** (Townsend).
— Medium sized species, 8 or 9 mm. in length, closely allied to *piperi* but differing from that species in its less robust form; less densely ciliated hind tibiae in male which bear one longer bristle; more sparsely bristled anal segment; genitalia appearing more slender, inner forceps bearing no conspicuous tuft of hairs; front less prominent; facialia weakly bristly one-half way; buccal area smaller; front pulvilli of male shorter and grayish rather than black____14. **schizurae** (Townsend).

1. ACHAETONEURA FRENCHII (Williston)

Masicera frenchii Williston, Scudder's Butterflies of New England, vol. 3, p. 1923, 1889.
Achaetoneura hesperus Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, pt. 5, p. 334, 1891.
Masicera datanarum Townsend, Trans. Amer. Ent. Soc., vol. 19, p. 287, 1892.
Frontina malacosomae Curran, Canad. Ent., vol. 57, p. 155, 1925.
Frontina sordida Curran, Trans. Roy. Soc. Canada, Sect. 5, p. 171, 1926, new name for *malacosomae* Curran, preoc.

Brauer and Bergenstamm described *hesperus* from some material sent them for determination by the United States Bureau of En-

tomology. They indicate no locality except North America, and returned no specimens labeled *hesperus*, although they marked several "Achaetoneura sp." One of these has been labeled by Townsend as probably *hesperus*. Apparently they did not label the types (they included more than one specimen, as in their part 6, 1893, p. 115, they say that the apical scutellars are "sometimes" erect), as it is understood that they did not retain any types. The specimen labeled by Townsend is undoubtedly *hesperus* Brauer and Bergenstamm and belongs to one of the varieties of the *frenchii* complex. Since *hesperus* is antedated by *frenchii*, its principal importance is that it is technically the genotype. Townsend's type of *M. datanarum* have not been located. The species was described from three specimens bred from *Datana* species and *Telea polyphemus*, also one collected specimen. From the description given, the species can not be differentiated from the *A. frenchii* complex, although Townsend[9] contends that it has a different facies. Provisionally, the species is best regarded as a variety of *frenchii*.

Frontina sordida Curran undoubtedly belongs to the *frenchii* complex. Certain specimens are readily identified but when one is confronted with a large series the separation of this form is unsatisfactory. In this, as well as in all other varieties of *frenchii* which have been studied, the puparia appear identical.

Because so few tachinids show such marked variations in the adult and inasmuch as there is a suspected distinctiveness of some of the variant forms, extreme care has been taken to describe, with exactness, some of the characters of the type which are believed to be unpublished.

According to Williston, the species was described from five specimens bred from (*Jasoniades*) *Papilio glaucus* Linnaeus, November 26, 1881, Moosehead Lake, Me. (S. H. Scudder). The type is pinned with the puparium and labeled "From Turnus, Nov. 15, 1881, Moosehead Lake, Me., S. H. Scudder, type 476, *Masicera frenchii*." There is also an unissued puparium labeled as is the above. I was unable to locate any more of the type material. The type specimen is a male. The abdomen has been broken off but the remainder of the fly is in good condition. According to the original description, the abdomen has no red on the sides. The following measurements were taken with an eyepiece micrometer.

Front at vertex 0.33 the head width; at widest part (base of antennae) 0.46 the head width. Width of bucca 0.20 the head height; second antennal joint 0.20 the third (measurement taken with head held in profile). Front projecting beyond the eye 0.28 the head width (head held in profile, measurement taken at base of anten-

[9] Smiths. Misc. Colls., No. 1803, p. 18, 1908.

nae). Front pulvilli nearly equal in length to the last two tarsal joints. Hind cross vein sinuate, distance from its end to small cross vein over twice its length; distance from end of hind cross vein to angle of fourth vein a little more than its length. Apical cell slightly open.

Face and front with slight yellowish cast which is by no means golden; facial depression cinereous, rather deep and about six times the width of either parafacial at narrowest part, the latter at this point less than the width of the third antennal joint. Vibrissal angles weak, the vibrissae a little above oral margin. Palpi very light yellow, thickly beset with short black spines. Antennae wholly black, excepting the extreme bases of second and third segments, which are faintly bordered with red. Arista thickened on basal third and then gradually tapering to apex. Facial ridges bristly three-fourths way to base of antennae. Frontals, eight in number, reaching from a point opposite the last bristles of the facial ridges to a point one-half way between base of antennae and vertex, the uppermost pair considerably weaker than the others. Two large reclinate bristles of equal strength continue along the line (a little outside) of the frontal rows. Inner vertical bristle strong, outer one much weaker and hardly differentiated from the immediate occipital hairs. Front vitta brownish, about one-third the width of front, sides of latter sparsely beset with weak bristles and hairs, none of which is equal in strength to the weakest frontal bristles. Occiput but slightly swollen below, at its greatest width scarcely equal to breadth of third antennal joint.

Thorax brownish black, moderately pollinose with the usual four vittae. Thoracic chaetotaxy: Before the suture, acrostichal 3; dorsocentral 3; posthumeral 3; humeral 3; presutural 2; behind the suture, acrostichal 3; dorsocentral 4; intraalar 3; supraalar 3; postalar 1. Scutellum brownish black, gray pollinose at base, the posterior third and entire border yellow as palpi and bearing three pairs of marginal bristles besides the cruciate apical pair, intermediate pair much weaker than the others; disk thickly beset with small hairs and bearing a pair of weak bristles.

Sternopleura with three strong and one weak bristles. Pteropleural bristle small, about the size of the weakest sternopleural bristle. Legs black. Mid tibiae with one long bristle on the outer front side near middle, above it a smaller one about one-half its size but much stronger than the adjacent ones: two hind bristles, the uppermost a little above middle; and also a strong inner bristle just below middle. The tibial spurs are as usual, one on outside, one in front, two on inner side, and a smaller one behind. Hind tibiae evenly ciliate with one longer bristle a little way below the middle.

Wings hyaline, third vein with three bristles at base and the costal spine short, scarcely discernible.

In his original description, Williston merely cites the characters which he considered differentiated the species from *archippivora*. Of the latter species his description of the abdomen reads as follows: "Abdomen black, short, thickly gray pollinose, variable in different reflections; second segment with a posterior pair of bristles, no median bristles on this and the next segment; the general covering of short bristles well differentiated from the long bristles."

The description that follows is of a male from Massachusetts bred from the same host as was Williston's species, compared with his type and regarded as typical. First segment black, subshining except at venter where it is thinly gray pollinose; second and third segments black, subshining, the dorsum and venter thinly gray pollinose, variable in different reflections but noticeably thicker at the bases, apices shining black both dorsally and ventrally; fourth segment black, gray pollinose, the tip black, subshining. First segment with one pair of median marginal bristles; second with a median marginal and lateral pair; third with a marginal row, the bristles of which are equal in length to dorsum of fourth segment; fourth wholly covered with bristles, the marginal and submarginal rows being much the strongest.

FIGURES 1 AND 2.—ACHAETONEURA FRENCHII (WILLISTON), MALE GENITALIA. 1, FROM BEHIND; 2, SIDE VIEW

Genitalia (figs. 1, 2) small, black, shining on sides, the dorsum without luster; forceps viewed from behind, at greatest width over one-half their length. Inner forceps shining black, fused for about one-half way, with the basal portions separated by a well defined keel. Viewed in profile, the inner forceps are slightly convex and terminate in blunt points, their length scarcely one-half the length of the fourth abdominal segment; outer forceps black or reddish, moderately broad at base and tapering slightly to rounded points.

Length, 6–7 mm.

The type is deposited in the Museum of Comparative Zoölogy, Cambridge, Mass.

The species is a decidedly complex one with a wide range and probably includes several undescribed forms which are at this mo-

ment inseparable on any characters known to the writer. In all of the material examined, the puparia (fig. 12) appear similar, the posterior spiracles are situated on about the same plane as the horizontal axis, and the slits vary in number and arrangement.

2. ACHAETONEURA EUCHAETIAE, new species

Differs from *A. frenchii* (Williston) in that the male genitalia are larger and of a different structure; thorax and abdomen more grayish pollinose; front pulvilli of male shorter; posterior spiracles of puparium situated some distance above longitudinal axis.

Front of male at vertex varying from 0.33 to 0.35, in female 0.32 to 0.35 the head width; at base of antennae, front of male 0.44 to 0.46, in female 0.41 to 0.47 the head width; buccal width varying from one-tenth to one-seventh the eye height; third antennal joint in male from four and one-half to five and one-half, in female from four to five times the second. Front in both sexes projecting beyond eye from one-half to three-fourths the eye width (head held in profile, measurement taken at base of antennae).

Front pulvilli of male about equal in length to the last tarsal joint. Hind cross-vein sinuate, distance from its end to small cross-vein varying from one-half to twice its length; distance from end of hind cross-vein to angle of fourth vein equal to or considerably less than its length. Apical cell open, third vein with two or three bristles at base.

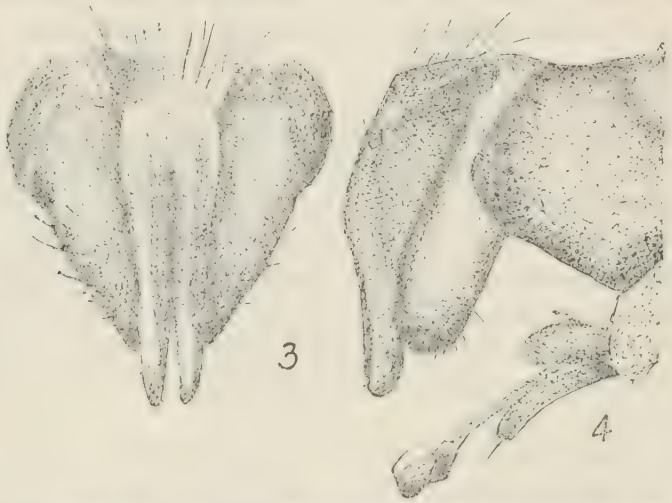
Face and front cinereous, the latter usually with yellowish cast; facial depression deep and more than three times wider than the width of one parafacial at narrowest part, which is at this point wider than the width of the third antennal joint. Occiput swollen below. Antennae in both sexes black, seldom even faintly reddish at base. Facial ridge bristles irregularly placed and often appearing as a double row. Frontal bristles variable in number, usually six or seven. Front of male densely beset with small bristles none of which equals in size those of the frontal row. Thorax and abdomen black, gray pollinose, usually sub-shining; thoracic chaetotaxy as in *frenchii*. Abdomen black, gray pollinose, anal segment densely so, never golden. First three segments bearing only marginal macrochaetae, the fourth moderately bristly on the apical three-fourths. Mid tibiae with one strong and one weak or two strong bristles on the outer front side; as in *frenchii* there are also two hind bristles and a strong inner one present on the mid tibiae. Hind tibiae evenly ciliate with one longer bristle.

Genitalia (figs. 3, 4) much larger than in the typical *frenchii*. Forceps viewed from behind, at widest part more than one-third their length; inner forceps fused at base and furnished with a very

short keel; viewed in profile, strongly convex on their outer edge and terminating in blunt points, their length equal to, or slightly more than one-half the length of the fourth abdominal segment; outer forceps broad, terminating in blunt rounded points.

Length, 9–11 mm.

The species is readily distinguished from all others of the genus by its puparium (fig. 13) which always has the posterior spiracles situated some distance above the longitudinal axis. It is further characterized by distinct biological traits. There is but a single generation, the host larvae being attacked in the early stages, the maggot hibernating in the first or second stage and completing its



FIGURES 3 AND 4.—ACHAETONEURA EUCHAETIAE, NEW SPECIES, MALE GENITALIA. 3, FROM BEHIND; 4, SIDE VIEW

development in midsummer. Rarely is there more than one parasite to each individual host.

Described from 25 specimens of both sexes reared at the Gipsy Moth Laboratory, from *Euchaetias egle* Drury, by J. V. Shaffner, jr., and others. The type (G. M. L. 12130 M9) is from Redwood, N. Y.; emergence date, July 18, 1927. The allotype (G. M. L. 12130 K5), from Hingham, Mass. The paratypes are as follows: 2 males, Newburgh, N. Y., May 26–29, 1924 (G. M. L. 12130 J8); 1 female, Saratoga Springs, N. Y., June 6, 1924 (G. M. L. 12130 J13); 1 male and 1 female, Crownpoint, N. Y., May 5–17, 1924 (G. M. L. 12130 J15); 2 males, Natural Bridge, N. Y., July 19, 1927 (G. M. L. 12130 M8); 3 males and 1 female, Hingham, Mass., July 8–9, 15–24, 1925 (G. M. L. 12130 K5); 1 male, Bernardsville, N. J., August 1, 1927 (G. M. L. 11741 M17); 2 males, North Branch, N. J., July 21–27, 1927 (G. M. L. 11741 M9); 1 female, North Branch, N. J., August 4, 1927 (G. M. L. 11741 M7); 1 male, Somerville, N. J., July 18, 1927 (G. M. L.

11741 M3); 1 female, Somerville, N. J., July 10, 1924 (G. M. L. 11741 J12); 1 female, Somerville, N. J., September 26, 1922 (G. M. L. 11741 H14); 1 male, Somerville, N. J., August 8, 1927 (G. M. L. 11741 M4); 1 female, Pierrepont, N. Y., July 27, 1927 (G. M. L. 12130 M12); 1 male, Bridgewater, N. J., August 9, 1927 (G. M. L. 11741 M6); 1 female, Holliston, Mass., July 13, 1925 (G. M. L. 12130 K6); 1 male, Milford, Pa., July 21, 1926 (G. M. L. 12130 L5). Other specimens from about the same localities as the above and from which the types were chosen, number close to 150 specimens.

Type.—Male. Cat. No. 43047, U.S.N.M.

3. ACHAETONEURA ANISOTAE, new species

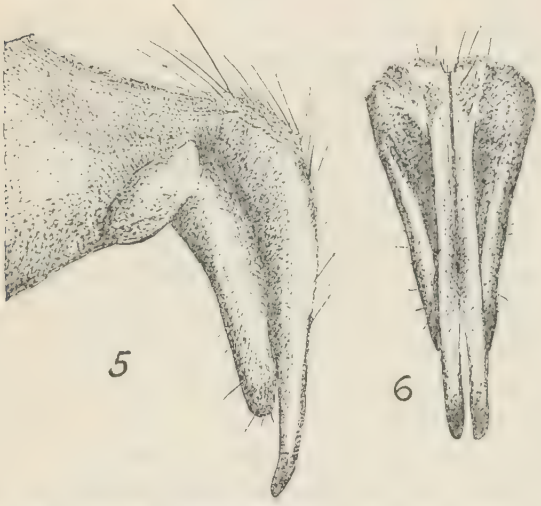
Differs from the closely allied species, *frenchii*, *cuchaetiae*, and *samiae* primarily in the structure of the male genitalia and the front tarsi of female.

Front of male at vertex varying from 0.28 to 0.29, in female 0.33 to 0.34 the head width; front at base of antennae, in male 0.37 to 0.39, in female 0.43 to 0.44 the head width; bucca measuring from one-fifth to one-seventh the eye height; third point of antennae in male from six to seven, and in female from four and one-half to five and one-half times the second. Front in both sexes projecting beyond eye from one-half to three-fourths eye width (head viewed in profile measurement taken at base of antennae). Front pulvilli of male equal to or somewhat longer than last tarsal joint. Front tarsi of female noticeably enlarged. This character appears constant in all of the material examined but it is not confined to *anisotae* alone. It occurs to some slight extent in the *frenchii* complex, especially in those forms bred from *Datana* spp. Hind cross vein sinuate, distance from the end to small cross vein variable, usually about one and a half times its length; distance from end of hind cross vein to angle of fourth vein equal to or considerably less than its length, last section of fourth vein usually sinuate, the angle rounded, apical cell open.

Face and front cinereous, usually the latter with a yellowish cast, more pronounced in female, facial depression deep and more than three times the width of one parafacial at narrowest part, which is at this point about the width of the third antennal joint. Occiput swollon below. Antennae in both sexes black, in female slightly reddish at junction of last two joints. Ciliation of facial ridges variable, usually a single row of evenly placed bristles, sometimes the bristles irregularly arranged and appearing as a double row.

Frontal row bristles varying in number from six to nine, usually the two uppermost pairs reclinate, in some specimens three pairs, or two on one side and three on the other. Front in both sexes

sparsely clothed with fine hairs and sometimes an occasional bristle, none of which, however, is equal in size to those of the frontal row. Thorax black, gray pollinose, usually subshining, the thoracic chaetotaxy as in *frenchii.* Scutellum black, gray pollinose, the apex sometimes reddish and bearing three pairs of strong and one pair of weaker marginal bristles besides the apical ones which are directed upwardly, being either parallel or cruciate. Abdomen black, gray pollinose, subshining; anal segment concolorous or with a yellowish tint, more pronounced in female. Sides of intermediate segments often reddish. First three segments with only marginal macrochaetae, the fourth moderately bristly on the apical three-fourths.



FIGURES 5 AND 6.—ACHAETONEURA ANISOTAE, NEW SPECIES, MALE GENITALIA. 5, SIDE VIEW; 6, FROM BEHIND

Mid tibiae with one strong and one smaller bristle above it, or rarely with two strong bristles of equal strength, on the outer front side. As in *frenchii* there are also two hind bristles and a strong inner one present on mid tibiae. Hind tibiae evenly ciliate with one longer bristle.

Genitalia (figs. 5, 6) much larger than in the typical *frenchii.* Forceps viewed from behind, at widest part less than one-third their length. Inner forceps fused for about one-half their length and furnished with well-defined keel; viewed in profile, they are sinuate, slender, and terminate in fine points, their length over three-fourths that of the length of the fourth abdominal segment; outer forceps slender, also terminating in fine points.

Length, 8–11 mm. Medium to large-sized flies decidedly more robust than the typical *frenchii* and usually attaining the maximum size.

The puparium appears similar to *frenchii;* the posterior spiracles are situated about on the longitudinal axis and the arrangement and number of slits apparently vary to a considerable extent.

Described from 25 speciments of both sexes reared at the Gypsy Moth Laboratory from *Anisota senatoria* Smith and Abbot, by J. V. Schaffner, jr., and others. The type (G. M. L. 11776 K1) is from New Brunswick, N. J.; date of emergence July 18, 1925. The allotype (G. M. L. 11776 K1) from New Brunswick, N. J. The para-

types as follows: 1 female, Cromwell, Conn., July 26, 1926 (G. M. L. 12431 L4); 1 male, Deep River, Conn., July 27, 1928 (G. M. L. 12431 N5); 4 males and 1 female, Westerly, R. I., June 26–July 13, 1922 (G. M. L. 12431 G6b); 1 male, Westerly, R. I., July 23, 1923 (G. M. L. 12431 H1); 1 male, Westerly, R. I., July 3, 1923 (G. M. L. 12431 H1a); 1 female, Alexandria, N. Y., July 26, 1926 (G. M. L. 12431 L1); 6 males and 2 females, New Brunswick, N. J., July 11–16–18–18–20–24, 1925–July–3–3, 1925 (G. M. L. 11776 K1); 2 males and 1 female, Mystic, Conn., July 11–19–30, 1923 (G. M. L. 12431 H1b); 1 male, Putnam, Conn., June 2, 1921 (G. M. L. 12431 F2b); 1 male, Deep River, Conn., July 19, 1928 (G. M. L. 12431 N5). Other specimens from the same localities as the above number about twenty-five.

Type.—Male. Cat. No. 43048, U.S.N.M.

4. ACHAETONEURA SAMIAE, new species

Differs from *frenchii*, *euchaetiae*, and *anisotae* in that the front has an irregular number of supernumerary bristles outside of the frontal row which are equal to the latter in strength. This character is more pronounced in the males. Fourth segment of abdomen densely bristly. Posterior spiracles of puparium in a depression and situated on longitudinal axis.

Front of male at vertex varying from 0.30 to 0.33, in female from 0.35 to 0.38 the head width; at base of antennae, front of male 0.39 to 0.44, in female 0.46 to 0.47 the head width; buccal width varying from one-eighth to one-fifth the eye height; third joint of antennae in male from four to five and in female from three and one-half to four times the second. Front in both sexes projecting beyond eye from one-fourth to nearly eye width, usually more so in female (head held in profile, measurement taken at base of antennae). Front pulvilli of male nearly equal in length to the last two tarsal joints. Hind cross vein sinuate, distance from its end to small cross vein varying from a little over once to twice its length, distance from end of hind cross vein to angle of fourth vein equal to or considerably less than its length. Apical cell open.

Front and face wholly cinereous or with slight yellowish cast, facial depression cinereous, often appearing soiled, deep, its width about three times that of one parafacial at narrowest part, which is at this point wider than the third antennal joint. Occiput swollen below. Antennae of male black, sometimes a little reddish at base, more so in female. Bristles of the facial ridges irregularly placed, often appearing as a double row. Frontal bristles variable in strength, number, and uniformity of alignment. Sides of front with a number of bristles equal in size to those of the frontal row. Oc-

casionally there are a few scattered fine hairs below the lowest frontal bristles.

Thorax and scutellum black, gray pollinose, usually subshining; thoracic chaetotaxy as in *frenchii*. Abdomen black, gray pollinose, the pollen varying greatly in density and pattern; anal segment usually concolorous with the remainder of abdomen, but frequently more thickly gray pollinose, never golden. First three segments of abdomen with marginal macrochaetae, the fourth wholly bristly, excepting the extreme base. Abdominal hairs often suberect along the dorsum.

Mid tibiae with one strong and one weak or, more rarely, with two strong bristles nearly equal in strength, on the outer front side.

FIGURES 7 AND 8.—ACHAETONEURA SAMIAE, NEW SPECIES, MALE GENITALIA. 7, FROM BEHIND; 8, SIDE VIEW

As in *frenchii*, there are also two hind bristles and a strong inner one present. Hind tibiae evenly ciliate with one longer bristle. Wings hyaline with one or two bristles at base of third vein.

Genitalia (figs. 7, 8) much larger than those of the typical *frenchii*. Forceps viewed from behind, at widest part, more than one-third as wide as long. Inner forceps black, fused for about one-half their length and furnished with a well-defined keel; viewed in profile nearly straight and tapering to fine points, their length nearly three-fourths that of length of fourth segment; outer forceps black or reddish, broad at base and moderately tapering to rounded points.

Length, 7–9 mm.

The species is readily distinguished from all others of the genus by its puparium (fig. 14), which is usually weak, light brown in color, with the posterior spiracles always located in a depression on

the horizontal axis. The species is further characterized in that there are two generations, the host larvae being attacked in their intermediate and later stages, the maggot hibernating in the third stage, and the adult emerging in the spring or early summer. It is rarely recovered solitarily from its host species.

Described from 25 specimens of both sexes reared at the Gipsy Moth Laboratory, from *Samia cecropia* Linnaeus, by J. V. Schaffner, jr., and others. The type (G. M. L. 12119 H4a) is from Glenborn, Me. (Carmel, Me., February 3, 1923); emergence date under laboratory conditions, March 1, 1923. The allotype (G. M. L. 12119 H4b), Carmel, Me. The paratypes as follows: 1 male and 1 female, Bangor, Me., March 24, 1922 (G. M. L. 12119 G5); 3 males and 4 females, Bangor, Me., March 23–27, 1923 (G. M. L. 12119 H4d); 2 males and 2 females, Bangor, Me., May 23–28, 1923 (G. M. L. 12119 H4g); 2 males, Greenfield, N. H., April 1–4, 1927 (G. M. L. 12119 N2); 2 females, Margaretville, N. Y., April 10–11, 1924 (G. M. L. 12119 J5); 1 female, Putnam Valley, N. Y., April 6, 1927 (G. M. L. 12119 N6); 1 male, Boxford, Mass., May 16, 1927 (G. M. L. 12119 N7); 2 males, Carmel, Me., February 3–13, 1923 (G. M. L. 12119 H4a); 2 males, Newport, R. I., April 17, 1924 (G. M. L. 12119 J6). Besides the type material, several hundred specimens, reared from *S. cecropia* from about the same localities as the above, have been examined. As regards distribution, it is interesting to note that there is material of this species at the United States National Museum bred from *Samia rubra* Behr, from California, by J. A. Kusche, 1919.

Type.—Male. Cat. No. 43049, U.S.N.M.

5. ACHAETONEURA MELALOPHAE Allen

Achaetoneura melalophae ALLEN, Trans. Amer. Ent. Soc., vol. 52, p. 195, 1926.

Male.—Front at narrowest part one-fourth diameter of head; face and front yellowish pollinose, often blackish at vertex. No strong bristles outside of frontal row; facial ridges bristly on lower half; antennae black, third joint in male about five and in female about four times the length of the second; bucca from one-fourth to one-fifth the eye height.

Thorax black, gray pollinose; scutellum often brownish at tip; chaetotaxy as in *frenchii*.

" Abdomen black or at most with an indistinct spot of red at sides of second segment, densely overlaid with gray pollen in which irregular black areas appear, when viewed from behind, in addition to two spots on median dorsal line; the rather coarse suberect bristly hairs are surrounded at their insertions by conspicuous round black

spots; fourth abdominal segment densely pollinose to apex" (Allen); first two segments with a median marginal pair, third with marginal row, and fourth more or less thickly bristly.

Legs black; mid tibiae with one strong bristle, sometimes one weaker one above it; hind tibiae evenly ciliate with one longer bristle, front pulvilli longer than last tarsal joint.

Wing venation as in *frenchii*.

Genitalia (fig. 9) apparently of the same structure as in the *frenchii* complex. Differs from the typical *frenchii* in that the entire genitalia are larger and the inner forceps are inclined inwardly at their apices and terminate in more slender points.

Length, 5–8 mm.

Distribution.—Eastern part of the United States.

FIGURE 9.—ACHAETONEURA MELALOPHAE ALLEN, MALE GENITALIA, SIDE VIEW

According to Allen, *melalophae* is readily distinguished by its more slender shape and smaller size, narrow front, deep golden pollen of face and front, and the mottled, yellowish gray pollination of the abdomen which is in contrast to the more uniform sheen of *frenchii*.

6. ACHAETONEURA CUCULLIAE, new species

Front of female at vertex 0.33, at base of antennae 0.41 the head width; front and face cinereous, the former without sheen, the latter more or less shiny; frontal bristles ten in number, the intermediate pairs weaker than those which precede or follow them, the two uppermost ones reclinate. When viewed from front, the inner eye margins are but slightly divergent; frontal bristles descending nearly or quite to the lower half of the head; facial ridges bristly on lower half, the uppermost bristles hardly reaching the lowest frontals. Two pairs of large proclinate orbital bristles; inner verticals large, the outer ones one-third their size. Facial depression cinereous, shining, and about four times as wide as either parafacial. The antennae appear to arise at a point about two-thirds the head height, black, the second joint about one-half the length of the third, and the arista tapering from base to apex. Palpi yellow; bucca narrow, about one-eight eye height.

Thorax black, gray pollinose, bearing four dorsocentral and four sternopleural bristles; lateral bristles strong. Scutellum with three pairs of marginal bristles besides the apical ones.

Abdomen black, thinly gray pollinose with a slight bluish cast; first segment black, destitute of bristles; second segment with one median pair; third with marginal row; fourth wholly covered with

bristles of unequal strength none of which is as long as those of the third segment.

Mid tibiae with one strong outside bristle near middle. Hind tibiae evenly ciliate with one long bristle.

Wing venation as in *frenchii*.

Length, 6–8 mm.

Described from one female labeled, "Emerged Sept. 27, 1917; from *Cucullia* sp., Falls Church, Va., Sept. 2, 1917." The puparium is pinned with the fly and seems to agree with that of *frenchii*.

Type.—Female. Cat. No. 43050, U.S.N.M.

Placed provisionally as this species are specimens of both sexes from the Gipsy Moth Laboratory, bred by J. V. Schaffner, jr., from *Dasylophia anguina* Smith and Abbot from larvae collected at Maybrook, N. Y., June 23–26, 1924 (G. M. L. 12164 J 147). This material, although agreeing fairly well with the type excepting in minor characters, may eventually prove to be a variety. Front of male 0.23, of female 0.30 the head width; at widest part (base of antennae), in male 0.40, in female 0.44 the head width. Bucca one-fifth the eye height, in female slightly less. Eyes very faintly pubescent. Face and front silvery pruinose. Frontals variable in number and not of uniform strength. Antennae black, the third joint in both sexes about two and one-fourth times the second. Arista gradually tapering. Facial ridges bristly one-half way. The thoracic chaetotaxy appears the same as in *cuculliae* excepting that, in some instances, the apical scutellar bristles are not directed upwardly. Abdomen black, gray pollinose, first segment without bristles, second with or without one strong median marginal pair, third with marginal row of strong bristles which are a fourth longer than any of these of the last segment, fourth segment moderately bristly, with well-defined marginal and submarginal rows, the latter strongest. In all of the specimens, the anal segment appears less bristlly above than in the type.

Legs black, the mid tibiae with one long bristle on outside near middle as in the type specimen; hind tibiae evenly ciliate with one longer bristle.

Length, 5–9 mm.

One female labeled, "Parasite on *Dasylophia anguina* Smith, Beverly, Mass. Collection G. V. Riley," and two females labeled, "5573o 2X, Sept., '92." The first of these three specimens is probably the one referred to *Frontina frenchii* or *aletiae* by Coquillett.[10] Another specimen, a female from Beltsville, Md., collected September 3, 1916, by W. S. McAtee, also appears to be of this species. In this specimen, the first segment bears no marginal bristles and the second has but one weak bristle and one longer hair.

[10] Revision of N. A. Tachinidae, p. 15–16, 1897.

7. ACHAETONEURA DIMMOCKI, new species

Front at vertex in male 0.30, in female 0.33 the head width; inner eye margins moderately divergent, a little more so in male than in female; front and face cinereous, the latter subshining and bearing several strong bristles outside of frontal row; frontal bristles variable in number and strength; frontal vitta broad, light-brown as are the eyes, and measuring about one-third width of front. Antennae in both sexes four-fifths the face, third joint black, the second brownish, in male about five times and in female three times the length of the second; arista thickened on basal half and tapering therefrom; facial ridges bristly about one-half way (weakly); palpi yellow; bucca one-eighth eye height.

Thorax black, gray pollinose, chaetotaxy as in *frenchii*. Scutellum brownish, black at base, and bearing three pairs of marginal bristles besides the decussate apical pair which lie either horizontally or upwardly directed. Disk with one pair of widely separated bristles which arise near the middle.

Abdomen black, gray pollinose, the pollen thickest in a narrow band at bases of segments two and three. Segments one and two each with a pair of marginal bristles, third with a marginal row of strong bristles, as long as the fourth segment and longer than any of the bristles thereon. Last segment bristly on its apical half; abdominal hairs of male erect, in female many erect short bristles or hairs extending along the dorsum of the abdomen which are in sharp contrast to the adjacent depressed hairs.

Mid tibiae with three or more strong bristles on the outer front side near middle. Hind tibiae evenly but not densely ciliate with one longer bristle. Front pulvilli of male longer than the last tarsal joint.

Wings with normal venation.

Genitalia apparently as in *frenchii* complex.

Length, 7–8 mm.

Described from two males and three females collected on *Rhus copallina*, June 5, 1898. Labeled "Springfield, Mass., G. Dimmock." The specimens bear the numbers, "1346—1346*a*—1346*b*—1346*d*—1346*E*. Also, one male and two females labeled, "bred from *Hyperchira io*., Tatham, Mass., July 15, G. Dimmock," numbered "1516*b*—1516*c*—1516*d*."

Type.—Male. Cat. No. 43051, U.S.N.M.

8. ACHAETONEURA ARCHIPPIVORA (Williston)

Tachina archippivora Riley, 3d Rept. Ent. Mo., p. 150, 1871 (no description or figure).

Masicera archippivora Williston, Scudder's Butterflies of New England, vol. 3, p. 1923, 1889.

Meigenia websteri TOWNSEND, Can. Ent., vol. 23, p. 206, 1891.
Phorocera promiscua TOWNSEND, Psyche, vol. 6, p. 84–85, 1891.
Ypophaemyia malacosomae TOWNSEND, Ins. Ins. Mens., vol. 4, Nos. 7–9, p. 75, 1916.
Parafrontina apicalis BRAUER and BERGENSTAMM, Zweif. Kais. Mus. Wien, pt. 6, p. 115, 1893.
Masicera pauciseta COQUILLETT, Revision of N. A. Tachinidae, p. 114, 1897.
Masiceropsis pauciseta (COQUILLETT) TOWNSEND, Ent. News, vol. 27, p. 178, 1916.

Meigenia websteri Townsend was considered by Coquillett (Revision of N. A. Tachinidae, p. 107; 1897) as a synonym of *frenchii*. Aldrich, who has seen the type specimen at the University of Kansas, believes it to be *archippivora* and not *frenchii*. According to Townsend's description, the face and front are nearly one-half the head width in female and about one-third in male, arista thickened for more than one-half its length, claws and pulvilli not elongated, all characters which would tend to corroborate Aldrich's determination. Townsend [11] evidently still considers the species distinct and further remarks that his recently erected *Ypophaemyia malacosomae* may prove to be a subspecies of it. In the United States National Museum there is a female specimen (C. V. Riley Collection), labelled "*Ypophaemyia websteri* Tns.," in Townsend's handwriting which I am unable to distinguish from *archippivora*. *Phorocera promiscua* Townsend was likewise considered synonymous with *frenchii* by Coquillett.[12] Aldrich has also seen the type specimen of this species and believes it to be *archippivora*. While the description of *P. promiscua* best fits *archippivora*, it will equally well apply to an unnamed variety of *frenchii* that is frequently bred from *Malacosoma* spp. and which, in some instances, so closely approaches *archippivora* that the separation of the two forms becomes extremely difficult. Townsend [13] still believes the species to be distinct from *frenchii* and *datanarum* although closely related to the latter. For the time being, at least, the species is best disposed of in the *archippivora* complex. The type specimens of *Ypophaemyia malacosomae* Townsend and *Masiceropsis pauciseta* (Coquillett) have been examined by the writer and the two species placed in the *archippivora* complex. Neither of them is identical with the type of *archippivora* but their counterparts are to be found in a series of specimens reared from host material collected in New England and which is, in most part, inseparable from *archippivora*. *Parafrontina* Brauer and Bergenstamm, type *apicalis* Brauer and Bergenstamm was considered by its authors as a subgenus of *Frontina*.[14]

[11] Ins. Ins. Mens., vol. 4, Nos. 7–9, p. 76, 1916.
[12] Revision, N. A. Tachinidae, p. 107, 1897.
[13] Smiths. Misc. Colls., No. 1803, p. 18, 1908.
[14] Zweif. Kais. Mus. Wien, pt. 6, p. 212, 1893.

Coquillett [15] believed the two genera to be synonymous as did also Aldrich.[16] Townsend [17] admits that there is a very close relationship between *Parafrontina*, *Achaetoneura*, *Masiceropsis*, and *Ypophaemyia* but differentiates the first from the others by its thickly pilose eyes. Obviously there is a mistake here, as an examination of the type material (Texas, Belfrage) shows the eyes to be distinctly naked. The species undoubtedly belongs to the *archippivora* complex even though not identical with the type of *archippivora*. *Ypophaemyia malacosomae brasiliensis* Townsend [18] from Brazil, *Zygofrontina capitas* Townsend [19] from Peru, and species from South America which are in the United States National Museum collection labelled "near *archippivora*" are allied and exceedingly close to *archippivora* but their distribution excludes them from consideration in this paper.

Front at vertex in male 0.35 to 0.38, in female 0.35 to 0.37 the head width; at widest part (base of antennae) in male 0.48 to 0.49, in female 0.48 to 0.50 the head width; width of bucca about one-sixth the eye height; third antennal joint in male from five to seven and in female four and one-half to five times the second; front projecting beyond eye from one-half to three-fourths eye width; front pulvilli of male less than length of last tarsal joint. Hind cross vein sinuate, distance from its end to small cross vein nearly twice its length, sometimes considerably less; distance from end of hind cross vein to angle of fourth vein about equal to its length or one-half again as much. Apical cell open.

Face and front cinereous, the former silvery, the latter often with golden tinge; facial depression shallow or deep, dependent upon drying; parafacials usually broad, at narrowest part wider than width of third antennal joint; palpi light yellow, sparsely bristly.

Antennae black, variable in length, usually about four-fifths the face, sometimes only three-fourths and frequently reaching the oral margin; viewed in profile, the outer edge of the third joint is normally straight, sometimes concave, black or reddish at base in male, in female often reddish on basal half and rarely entirely red. Arista thickened on basal one-half to three-fourths. Facial ridges usually bristly three-fourths way to antennae, sometimes only one-half way. Frontal bristles variable, usually eight or nine with the uppermost ones weak, usually two large reclinate bristles of about equal strength continuing along the line (a little outside) of the frontal rows. Inner vertical bristle strong, outer one about one-

[15] Revision of N. A. Tachinidae, p. 105, 1897.
[16] Cat. Dipt., p. 462, 1905.
[17] Bull. Amer. Mus. Nat. Hist., art. 6, vol. 37, p. 232, 1917.
[18] Idem., p. 231, 1917.
[19] Proc. U. S. National Museum, vol. 49, No. 2115, p. 427, 1915.

fourth its size. Frontal vitta variable in breadth and outline, usually the sides nearly parallel from base of antennae to the lowest ocellus, sometimes rapidly divergent. Front, outside of frontal rows, in male sparsely bristly or sometimes with one to three bristles the size of the weakest frontals, in female this region very weakly hairy. Occiput slightly swollen below.

Thorax black, gray pollinose, variable in density and usually with a goldent cast. Thoracic chaetotaxy: Before the suture, acrostichal 3; dorsocentral 3; posthumeral 3; humeral 3; presutural 2; behind the suture, acrostichal 3; dorsocentral 3; intraalar 3; postalar 1. Scutellum black, gray pollinose, the tip often yellowish or red and bearing three pairs of marginal bristles besides the usually cruciate apical pair which are rarely parallel. Sternopleura usually with four bristles. Pteropleural bristle small, about the size of the weakest sternopleural bristle.

FIGURES 10 AND 11.—ACHAETONEURA ARCHIPIVORA (WILLISTON), MALE GENITALIA. 10, FROM BEHIND; 11, SIDE VIEW

Abdomen black, gray pollinose, with or without a yellowish tinge, the pollen variable in density although as a rule much more thickly pollinose than in *frenchii;* sides of second segment concolorous with the rest of the abdomen or reddish. First segment usually without median marginal bristles, although sometimes a weak pair are present; second segment with one pair median marginal, or rarely without any: third with marginal row, fourth with a weak marginal row and a much stronger submarginal one. Basal three-fourths of this segment destitute of strong bristles. Abdominal hairs depressed.

Legs black, sometimes brownish, mid tibiae usually with one strong and one weaker bristle above it or only one strong bristle on outer front side, two hind bristles, the uppermost a little above the middle, and also a strong inner bristle just below middle. Tibial spurs as usal. Hind tibiae evenly ciliated with one longer bristle. Wings hyaline, third vein with two or three bristles at base; costal spine short, scarcely discernible.

Genitalia (figs. 10, 11) black in most part, outer forceps brownish; forceps viewed from behind at widest part over one-half as wide as long; viewed in profile, the inner forceps slender, tapering slightly to fine points, almost straight, and with a very slight concav-

ity on the outer side near their apices, their length measuring about three-fourths that of the fourth segment; outer forceps broad, tapering but slightly to blunt rounded points.

Length, 5–8 mm.

The species appears to be widely distributed over the United States.

9. ACHAETONEURA TEXANA, new species

Front at vertex in both sexes 0.41 the head width; front, face, and postorbital region deep golden pollinose, facial depression less so; frontal vitta in male one-fourth the frontal width, in female somewhat wider. Lowest and uppermost frontal bristles strongest, the intermediate ones weak, facial ridges bristly a little over one-half way in male, in female nearly three-fourths way. Bucca about one-eighth the eye height, palpi yellow, swollen at tip and in male thickly clothed with short black hairs which give it a very dark appearance.

Thorax black, gray pollinose, bearing four dorsocentral and four sternopleural bristles; scutellum with four pairs of marginal bristles besides the apical pair which in the type specimen are parallel and directed upward, in female decussate.

Abdomen black, gray pollinose, anal segment golden pollinose; first and second segment with median marginal bristles, third with a marginal row of strong bristles which are longer than any of those of the fourth segment; fourth segment bristly on apical two-thirds.

Mid tibiae with one long and one shorter bristle above it on the outer front side near middle. Hind tibiae evenly ciliate with one longer bristle. Front pulvilli of male less than the length of the last tarsal joint.

Genitalia apparently as in *archippivora*.

Wing venation normal, hind cross vein noticeably sinuate.

Length, 9–10 mm.

Described from one male collected at Dilly, Texas, labeled "LI, 1924, #2 Reinhard" and one female labeled: "Dist. Fedrl. Mex. L. Conradi, Collector—37."

Type.—Male. Cat. No. 43052, U.S.N.M.

10. ACHAETONEURA WESTONIA, new species

Front of male 0.47 the head width; inner eye margins nearly parallel; facial ridges bearing two rows of irregularly placed bristles which extend three-fourths way to base of antennae; parafacials broad, at narrowest part each one-half as wide as the facial depression; bucca one-third eye height; vibrissae on level with oral margin; antennae black, five-sixths the length of face; third joint over six times the length of second; palpi yellow, slender, not swollen at tip.

Thorax black, gray pollinose, bearing four dorsocentral and four strong sternopleural bristles. Scutellum brownish with three pairs of marginal bristles besides the decussate apical pair, also a discal pair.

Abdomen black, quite thickly gray pollinose as in *archippivora* and bearing median marginal bristles on the first three segments, the fourth bristly on its apical half.

Mid tibiae with one large and one small bristle above it on outer front side near middle. Hind tibiae evenly ciliate with one longer bristle. Front pulvilli of male less than length of last tarsal joint.

Wing venation normal, base of third vein with two or three bristles; costal spine small but distinct in the type specimen.

Genitalia apparently as in *archippivora.*

Length, 10 mm.

Described from one male from Alameda County, Calif.; labeled: "Feb. 45 °."

Type.—Male. Cat. No. 43053, U.S.N.M.

11. ACHAETONEURA TESTACEA, new species

Frontina violenta COQUILLETT, Revision of N. A. Tachinidae, p. 108, 1897 (not Walker List of Dipterous Insects, part 4, p. 788, 1849).

Front of male at narrowest part (a point half way between vertex and base of antennae) 0.24 the head width, in female the front at narrowest point (vertex) 0.30 the head width; facial ridges bristly from one-third to one-half way to antennae. Front and face cinereous, the former with slight golden tinge; antennae black, third joint in male three and one-half to four, and in female from three to three and one-half times the second; bucca about one-fifth eye height.

Thorax black, gray pollinose; chaetotaxy as in *frenchii;* scutellum with three pairs of strong marginal bristles besides a pair of cruciate apical ones.

Abdomen stout, yellow or brownish in color with a poorly defined, wide, black dorsal vitta which extends over the larger part of dorsum, in female the anal segment mostly gray pollinose; first segment without marginal bristles; second segment with one pair of strong median marginal bristles; third with a marginal row of strong bristles which are longer than those of the fourth segment; fourth segment bristly on apical two-thirds, the bristles of unequal strength, those at apex being strongest.

Legs brownish. Mid tibiae with one long bristle on outer front side near middle; hind tibiae ciliate with one longer bristle. Front pulvilli of male longer than last tarsal joint.

Wing venation normal.

Length, 7–8 mm.

The species is described from two males and two females bred from *Pholus vitis* Linnaeus, Washington, D. C., the flies issuing October 8, 1884; also a specimen collected by R. P. Currie, Plummer Island, Md., June 3, 1902.

The reared specimens are evidently some of the material Coquillett had before him when working on his Revision of Tachinidae. The species is exceedingly close to *aletiae* (Riley) from which it is differentiated principally by its marginal bristles on the second abdominal segement and color characters; *testacea* differs from *pholi* in its more slender form, coloration and density of pollen along the thorax, the latter character being readily recognized when a series of specimens are examined.

Type.—Male. Cat. No. 43054, U.S.N.M., from Washington.

12. ACHAETONEURA ALETIAE (Riley)

Tachina aletiae RILEY, Can Ent., vol 11, p. 162, 1879.
Tachina fraterna COMSTOCK, Rept. Commr. Agri., 1879, p. 303, 1880.

The type specimen can not be located in the United States National Museum. Such being the case, the species is redescribed from one male and two females from Centerville, Fla., which are considered as typical. These specimens were reared from *Alabama argillacea* Hübner and are labelled, "#468 *L08*, issued Nov. 23, 1878." Another female varying but slightly from the above is included as typical. This specimen is labelled as follows: "#2359—bred from *aletiae* pupae, disclosed Aug. 21, 1881, Hubbard; collection C. V. Riley—104." It also bears Brauer and Bergenstamm determination label, "*Prosopaca* sp." and is evidently the specimen sent by Riley to them for identification.[20] The specimens above compare well with Riley's description excepting in the case of the one labeled *Prosopaea*, in which case the front and face are cinereous without trace of golden pollen.

Front of male at vertex 0.26, at widest part 0.34 the head width; in female at vertex 0.27, at widest part 0.34 the head width; face and front concolorous, ashy gray ground color tinged with golden; frontal vitta one-third the frontal width; frontals nine in number, the last two pairs reclinate. Antennae black, second joint brownish, in male about one-fourth the length of third, in female about one-third. Facial ridges weakly or strongly bristly for one-half to three-fourths their length. Bucca narrow, about one-tenth the eye height. Palpi yellow, eyes sparsely but distinctly pubescent under high magnification.

[20] See Coquillett's Revision N. A. Tachinidae, footnote No. 2, p. 105, 1897.

Thorax black, gray pollinose; chaetotaxy as in *frenchii*. Scutellum brownish, bearing four pairs of strong marginal bristles (the second pair from suture weakest) besides a cruciate apical pair.

Abdomen black, gray pollinose, particularly the bases of last three segments, sides of first and second segments sometimes reddish, anal segment sometimes wholly gray pollinose; no longer hairs or indication of marginal bristles on the first two segments; third with a marginal row which in the female are not so long as the fourth segment; in male the bristles of the third segment are stronger and equal to, if not longer than the fourth segment, fourth segment bristly on apical half, the bristles stronger in male than in female.

Legs black with a piceous tinge. Front pulvilli of male as long as last tarsal joint. Hind tibiae ciliate with one longer bristle. Mid tibiae with one long and one short bristle above it on the outer front side near middle.

Genitalia of male brownish; forceps viewed from behind at widest part scarcely half as wide as long; in profile the inner forceps are straight, sparsely hairy at base and along their sides, outer forceps stout.

Length, 8–9 mm.

The species appears to have a wide range in the United States.

13. ACHAETONEURA PHOLI, new species

Front of male at vertex 0.25, of female 0.28 the head width; face and front cinereous, the latter with a golden tinge; frontal bristles variable, in the male a row of eight to ten bristles of unequal strength besides the two reclinate upper fronto-orbital ones, in the female usually the lowest five or six strong, followed by several weaker ones; facialia of male weakly bristly for at least half their length, in female scarcely over one-third way; third joint of antennae in male four and one-half times, and in female four times the length of the second, second joint and base of third brownish, this color more conspicuous in the female; bucca one-sixth the eye height; palpi light yellow, swollen at tip and sparsely clothed with black hairs.

Thorax black, thickly gray pollinose tinged with yellow; sternopleural plate light gray pollinose; chaetotaxy as in *frenchii*. Scutellum black, gray pollinose, the tip brownish and bearing four pairs of marginal bristles besides the cruciate apical ones.

Abdomen black, subshining, bases of segments two to four grayish pollinose, the pollen especially noticeable on sides of intermediate segments, in female the pollen is of a lighter shade; first segment without median marginal bristles; second with a marginal pair scarcely discernible from the adjacent hairs, stronger in female;

third segment with marginal row of strong bristles which are longer than the fourth segment or any of the bristles thereon; fourth segment moderately bristly on its apical three-fourths. Abdominal hairs depressed.

The genitalia differ from those of *aletiae* in that, when viewed in profile, the tips of the inner forceps are turned backward and the sides and base of the forceps are more thickly bristly; outer forceps more slender.

Legs black, mid tibiae in male with one long bristle on the outside near middle, no trace of smaller one above it, in female one long and one short bristle. Hind tibiae thickly and evenly ciliate without any longer bristles; front pulvilli of male longer than last tarsal joint.

Wing venation normal.

Length, 8–9 mm.

Described from four males and eleven females reared from *Pholus* species, Springfield, Mass, (No. 2103) by G. Dimmock.

Type.—Male. Cat. No. 43055, U.S.N.M.

14. ACHAETONEURA SCHIZURAE (Townsend)

Masicera schizurae TOWNSEND, Psyche, vol. 6, p. 187, 1891.

Front of male at vertex 0.23 the head width; at widest part (base of antennae) 0.38 the head width; cinerous, as is also the entire face, no brassy tinge obvious; frontal bristles in a single row, one or two smaller bristles outside of them; facial ridges bristly about one-half way, the bristles not of equal strength; bucca one-eighth the eye height; antennae black, the third joint in male at least five times the second.

Thorax black, gray pollinose, the chaetotaxy as in *frenchii;* scutellum brownish, with four pairs of marginal bristles, the second pair from suture weakest; apical scutellar bristles short, vestigial in the type specimen.

Abdomen black, gray pollinose, the sides with a brownish tinge; abdominal hairs depressed. First segment black, without marginal bristles; second with a median pair (according to description these bristles are sometimes absent); third with a marginal row; fourth with long bristles on the apical border only.

Genitalia of male wholly brownish, apparently of the same structure as in *piperi* but more slender and lacking the conspicuous tuft of hairs at base of inner forceps.

Legs piceous, mid tibiae with one long and one shorter bristle above it. Hind tibiae evenly but not so densely ciliate as in *piperi* and with one longer bristle. Front pulvilli of male grayish, very long, nearly twice that of the last tarsal segment.

Wings with normal venation.

Length, 8–9 mm.

The above description is of one of the cotype specimens and varies somewhat from Townsend's description. His four specimens were reared from *Schizura unicornis* Smith and Abbot, at Manhattan, Kansas. Although considered synonymous by Coquillett, the species is positively not *frenchii* (Williston). In general appearance, the species resembles *testacea* but differs in form and coloration. The latter is small and more compact, *schizurae* larger and more robust with the apical scutellar bristles vestigial; it differs from *piperi* by its smaller and more slender form, the presence of one longer bristle among the even cilia of hind tibiae in male and the absence of a conspicuous tuft of hairs at base of inner forceps; from *frenchii* it may be separated by the absence of marginal bristles on the first segment, absence of strong apical scutellar bristles, and arrangement of bristles on the posterior segment of abdomen.

Townsend[21] mentions *M. schizurae* as having been bred from larvae and pupae of *Euchaetias egle*, by S. A. Forbes, Illinois. In view of the fact that several species of *Achaetoneura* are separated with difficulty from *schizurae*, some confusion may exist as regards this record.

15. ACHAETONEURA PIPERI (Townsend)

Sturmia schizurae COQUILLETT, Revision of N. A. Tachinidae, p. 113, 1897.

Argyrophylax piperi TOWNSEND, Smiths. Misc. Colls., No. 1803, p. 98, 1908, change of name.

Achaetoneura schizurae ALDRICH, Proc. Ent. Soc. Wash., vol. 31, p. 36, 1929.

The essential characters which distinguish *piperi* have been given in the table of species. The species is recognizable from Coquillett's description, to which may be added the following: Large robust forms, 10 to 12 mm. in length, the largest of the Achaetoneuras. Front of male at vertex 0.23, of female 0.30 the head width; at base of antennae, front of male 0.38, of female 0.41 the head width; horizontal diameter of head at vibrissae fully three-fourths that at base of antennae; front and face cinereous; facial ridges bristly from one-half to three-fourths way to the antennae; third antennal joint in male about four, in female, hardly three times the second, very broad, its length scarcely three times its breadth. In the female, the sides of the front are destitute of strong bristles outside of the frontal row; parafacials narrow in female, about one-fourth in median depression. Buccal area large when viewed from beneath, viewed from side the bucca about one-fifth the eye height.

[21] Psyche, vol. 6, p. 467, 1893.

Thorax black, gray pollinose, the chaetotaxy as in *frenchii;* scutellum with four strong pairs of marginal bristles, also intermediate weaker ones besides the extremely week apical pair.

Abdomen black, gray pollinose, first segment bare, second and third segments with marginal bristles, the fourth wholly covered except at extreme base, bristles at apex strongest. Abdominal hairs depressed.

The genitalia do not appear to have any characters to specifically differentiate the species from some of the closely allied species. They are light brown or yellowish in color, shining, and, when viewed from behind, the forceps at greatest width are nearly one-half their length; outer forceps stout; inner forceps a little longer than the outer and bearing at base a small but conspicuous tuft of upwardly directed hairs.

Mid tibiae with one large bristle and a smaller one above it on the outer front side near middle. Hind tibiae evenly and densely ciliate without a longer bristle in male; evenly, though less densely ciliate and bearing one longer bristle in the female. Front pulvilli of male smoky black and decidedly longer than last tarsal joint.

Wing venation normal, third vein at base with two or three bristles as in *frenchii.*

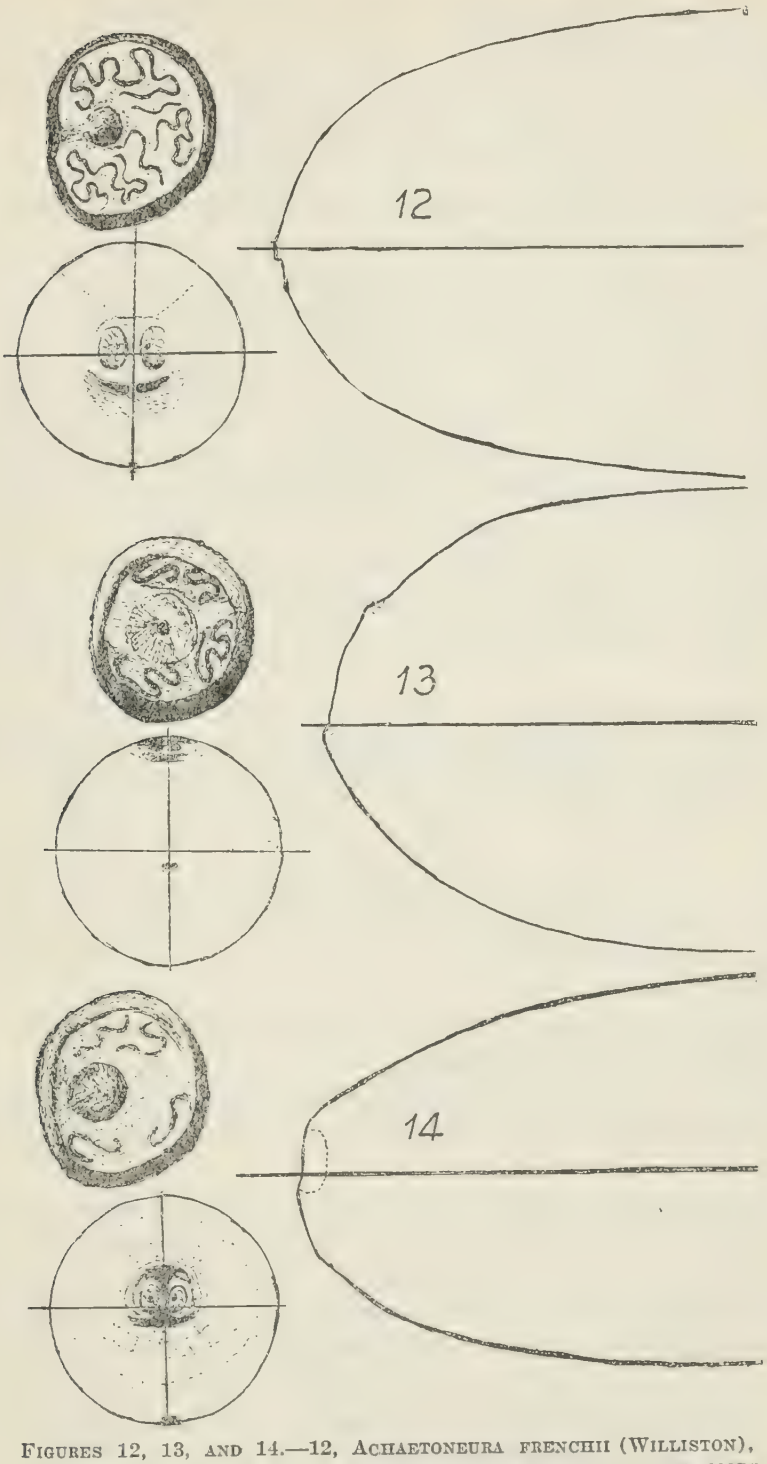
The material examined at the United States National Museum consisted of the type, a male reared from *Schizura ipomoeae* Doubleday, Pullman, Wash., and two females of the same lot from Coquillett's and Aldrich's material.

Piperi is exceedingly close to *schizurae* (Townsend) and can be separated from that species with difficulty. Nearest comparable in size is *anisotae* from which it is distinguished in the male by the densely and evenly ciliated hind tibiae without longer bristle, in female by its shorter and broader third antennal joint, narrow parafacials, and total absence of any strong bristles outside of the frontal row.

Townsend [22] placed *Sturmia schizurae* Coquillett, in *Argyrophylax* Brauer and Bergenstamm.

The specific name was preoccupied by *Argyrophylax schizurae* Townsend, so he gave it a new name, *piperi.* According to Walton,[23] Townsend was mistaken in referring *schizurae* Coquillett to *Argyrophylax* and this is obvious from a study of the type description. Some of the principal characters of the genus *Argyrophylax* are the absence of ocellar bristles, the narrow cheeks, and weakly ciliated facialia, and as *schizurae* Coquillett has not these characters, it can hardly be an *Argyrophylax* and is referred by the writer to *Achaetoneura.* Since the name *schizurae* is preoccupied in *Achaetoneura,*

[22] Smiths. Misc. Colls. No. 1803, p. 98, 1908.
[23] Proc. Ent. Soc. Wash., vol. 18, p. 189–192, 1916.



FIGURES 12, 13, AND 14.—12, ACHAETONEURA FRENCHII (WILLISTON), PUPARIUM FROM SIDE AND END AND RIGHT SPIRACULAR PLATE MORE HIGHLY MAGNIFIED. 13, A. EUCHAETIAE, NEW SPECIES, SAME VIEWS AS IN FIGURE 12. 14, A. SAMIAE, NEW SPECIES, SAME VIEWS AS IN FIGURE 12

Townsend's name of *piperi* is retained for Coquillett's *schizurae*. Aldrich failed to note that *schizurae* (Townsend) 1891 is also an *Achaetoneura*, hence he regarded the new name *piperi* unnecessary.

16. ACHAETONEURA RILEYI (Williston)

Masicera rileyi Williston, Scudder's Butterflies of New England, vol. 3, p. 1924, pl. 89, figs. 22–24, 1889.

Front of male at vertex 0.31 to 0.29, at widest part 0.41 to 0.39, in female at vertex 0.32 to 0.33, at widest part 0.40 to 0.41 the head width. In quite a few specimens there appears to be little or no difference in the width of the front as regards sex. Front and face cinereous; inner eye margins moderately divergent. Antennae in both sexes about three-fourths the length of the face; second joint yellowish, a little less than one-half the length of the third, the latter black; bucca one-fifth the head height.

Thorax black, gray pollinose; the chaetotaxy as in *frenchii;* scutellum with four pairs of marginal bristles besides the apical ones, the bristles nearest the suture and those nearest the apical pair strongest.

Abdomen brownish in most part with a well-marked black dorsal vitta. Bases of last three segments with narrow borders of light grayish pollen. Usually the first and second segments are destitute of macrochaetae but sometimes a weak pair are present on segment 2.

Mid tibiae with one strong bristle on the outer front side near middle. Hind tibiae evenly ciliated without a longer bristle.

Wing venation normal.

Length, 7–8 mm.

Redescribed from a number of specimens of both sexes at the United States National Museum.

The species was originally described by Williston from material (both sexes) reared by C. W. Riley, from *Papilio thoas* Linnaeus, locality not given.

Coquillett [24] had considered *rileyi* as a synonym of *irrequieta* Walker but later, in his manuscript notes, regarded the two as distinct. Aldrich [25] also regarded them as distinct. At the United States National Museum the species was placed in *Thysanomyia* Brauer and Bergenstamm, presumably by Townsend, but as the type of that genus, *Brachycoma fimbriata* v. d. Wulp, has the vibrissae well above the oral margin and other differences also, *rileyi* certainly can not be of that genus and is best regarded as an *Achaetoneura*.

[24] Revision N. A. Tachinidae, p. 108, 1897.
[25] Cat. Dipt., p. 463, 1905.

17. ACHAETONEURA LANIIFERAE, new species

Front of male at vertex 0.28, at widest part 0.43, in female at vertex 0.32, at widest part 0.42 of the head width; front and face golden pollinose. Inner eye margins divergent, the eyes widely separated below. Antennae in both sexes three-fourths length of face; second joint yellowish, about one-half as long as third, the latter black; bucca one-fifth the eye height.

Thorax black, gray pollinose, the chaetotaxy as in *frenchii;* scutellum brownish, bearing four pairs of marginal bristles besides a weak apical pair; the bristles nearest the suture and those nearest the apical pair strongest.

Abdomen more or less brownish in ground color, thinly grayish pollinose, the anal segment yellowish or yellowish brown, gray pollinose. No vitta or definite pattern obvious along the dorsum, first and second segments with weak marginal bristles scarcely distinguishable from the adjacent hairs. Abdominal hairs depressed.

Mid tibiae with one strong bristle on the outer front side near middle. Hind tibiae evenly ciliated without a longer bristle.

Wings with normal venation.

Length, 8–9 mm.

Described from a specimen of each sex reared from a cocoon of *Laniifera cyclades*, collected January 1, 1927, the flies issuing May, 1927. Both specimens are labeled, " 51." Locality: Mexico.

Type.—Male. Cat. No. 43056, U.S.N.M.

18. ACHAETONEURA FERRUGINEA (Reinhard)

Frontina ferruginea REINHARD, Ent. News, vol. 35, p. 269, 1924.

Front at vertex about one-third head width, cinereous, face silvery white, slightly receding, facialia bristly three-fourths way in male, slightly less so in female; bucca narrow, about one-fifth the eye height. Antennae black, as long as face, third joint in male six or seven, and in female five or six times longer than the abbreviated second.

Thorax black, gray pollinose, the chaetotaxy as in *frenchii;* scutellum with three pairs of marginal bristles besides the cruciate apical pair.

Abdomen slender, reddish yellow, with a well defined black dorsal vitta; all segments with marginal bristles, those of the anal segment being equal in size to those of the third.

Legs black, basal joints sometimes yellowish. Mid tibiae with one long and one small bristle above it on outer front side; hind

tibiae evenly ciliate with one longer bristle. Front pulvilli of male less than length of the last tarsal joint.

Wings with normal venation.

Length, 5–7 mm.

Distribution.—College Station, Texas.

The species is readily recognized from Reinhard's fine description. *A. testacea*, which it most closely resembles, has a narrower front, third antennal joint shorter, and other differences.

19. ACHAETONEURA SPECTABILIS (Aldrich)

Frontina spectabilis ALDRICH, Canad. Ent., vol. 48, p. 21, 1916.

This species is the only one of the Achaetoneuras that is clothed with dense golden pollen. Although Aldrich described only the female, the species can be readily recognized from his description.

Front in male 0.29, in female 0.33 the head width, golden pollinose, the vitta brownish; face silvery, third antennal joint in male six times and in female four times the length of the second; facial ridges bristly one-half way.

Thorax black in ground color with heavy golden pollen, bearing four dorso-central and usually three sternopleural bristles; scutellum with three pairs of marginal bristles besides the apical cruciate pair.

Abdomen black, golden pollinose, the narrow apices of segments two, three and four shining black, first segment usually without marginal bristles, second with or without a marginal pair, third with a marginal row, the fourth with a strong submarginal row.

Legs black, sometimes brownish; mid tibiae with one long bristle on outer front side, hind tibiae evenly cliate with one longer bristle.

Wings with normal venation.

Length, 6–7 mm.

Distribution.—Ontario and Massachusetts.

The type specimen is deposited in the Canadian National Museum and has not been seen by the author. The brief description given herein is from material of both sexes determined by Aldrich.

Disposal of species not otherwise accounted for which have, at one time or another, been referred to *Frontina* or *Achaetoneura:*

acroglossoides TOWNSEND (*Frontina*), Trans, Amer, Ent. Soc., vol. 18, p. 367, 1891.

Synonymous with *Chaetogaedia analis* v. d. Wulp.

americana BIGOT (*Prosopea*), Ann. Ent. Soc. France, p. 260, 1888, Mexico.

According to Aldrich (Cat. Dipt., p. 462; 1905) *Prospheryea contigua* v. d. Wulp (Biologia, Dipt., vol. 2, p. 120, Morelos, Mex.) is synonymous with *americana*. The species is unknown to the writer.

ancilla WALKER (*Tachina*), Insecta Saundersiana, vol. 1, p. 299, 1856.

Austen (Ann. and Mag. Nat. Hist., ser. 7, vol. 19, p. 337, 1907) believes that *T. ancilla* is correctly referred to *Frontina* by Coquillett, Townsend, (Proc. Ent. Soc. Wash., vol. 20, no. 1, p. 21, 1918) has apparently seen Walker's *ancilla* and considers it a *Pseudomyothyria.*

ancilla COQUILLETT (*Frontina*), Revision of N. A. Tachinidae, p. 106, 1897.

For Coquillett's species, misidentified as *F. ancilla* Walker, Townsend (Proc. Ent. Soc. Wash., vol. 20, No. 1, p. 21, 1918), erected a new genus and species, *Frontiniella parancilla* (by misprint *pararcilla*) which appears to have good standing.

anonyma RILEY (*Tachina*), 4th Rept. Ent. Mo., p. 129, 1872.

For the sake of reference. Doctor Riley provisionally used this name for a fly that he reared from *Telea polyphemus.* No recognizable description or figure was given. It was also mentioned by Riley that this same species has been reared from a number of different hosts.

In his later Reports on the Insects of Missouri, 5th, pp. 133–139, 1873; 7th, p. 178, 1875; 8th, p. 179, 1876; also in the First Report of the U. S. Entomological Commission, p. 323, 1878, reference is again made to *anonyma* with additional new host species. In the United States National Museum there are some of Riley's specimens bred from *Caloptenus spretus* Thomas and *Oedipoda carolina* Linnaeus, and which are perhaps what he considered *anonyma.* So far as these specimens are concerned I am unable to separate them from material reared from *Datana angusii* Grote and which in this paper is considered to belong to the *frenchii* complex. There is no assurance, however, that they are the same as *anonyma,* and in that the proposed type specimen can not be located or the species positively identified it is best left unrecognized.

apicalis v. d. WULP (*Prospherysa*), Biologia, Dipt., vol. 2, p. 122, 1890, Mexico.

Assigned to *Prospherysa* by the describer but referred to *Achaetoneura* by Brauer and Bergenstamm (Zweif. Kais. Mus. Wien, pt. 5, pp. 334 and 401, 1891). Unrecognized.

armigera COQUILLETT (*Tachina*), Insect Life, vol. 1, p. 332, 1889.

The presence of infra-squamal setulae, the female with ventral abdominal keel armed with spines and with a sharp piecer are characters which exclude it from *Achaetoneura.* Townsend (Ann. Ent. Soc. Amer., vol. 2, p. 249, 1909) makes *armigera* Coquillett the type of his new genus *Eucelatoria.* Curran (Can. Ent., vol. 59, p. 12, 1927) refers the species to *Lydella.*

barbatula v. d. WULP (*Brachycoma*), Biologia, Dipt., vol. 2, p. 98, 1890, Mexico.

Assigned to *Brachycoma* by describer but referred to *Achaetoneura* by Brauer and Bergenstamm (Zweif. Kais. Mus. Wien, pt. 5, pp. 334 and 401, 1891). Unrecognized.

bigeminata CURRAN (*Frontina*), Amer. Mus. Novit., No. 260, p. 9, 1927.

The species has not been seen by the writer but from its description it can be excluded from *Achaetoneura* as defined herein by the following characters: Strongly receding face, weak ocellars, black palpi, narrow parafacials, and different chaetotaxy. Provisionally, the species is referred to *Masicera* of Coquillett's Revision.

chrysopygata BIGOT (*Frontina*), Ann. Ent. Soc. France, p. 84, 1888, Mexico.—Brauer, Sitzungsbericht d. k. Akad., vol. 106, p. 28, 1897.

According to Aldrich (Cat. Dipt., p. 463, 1905) the types are a mixture of two species, of which the specimen corresponding to the description has no locality label. The species is unrecognized.

dubia WILLISTON (*Masicera*), Scudder's Butterflies of New England, vol. 3, p. 1924, 1889.

Coquillett (Revision of N. A. Tachinidae, p. 108, 1897) considered *dubia* synonymous with *violenta* Walker but Aldrich (Cat. Dipt., p. 463, 1905) does not agree, believing it to be distinct. The species was bred by Riley from *Vanessa antiopa* Linnaeus and from *Pholus* (*Philampelus*) *vitis* Linnaeus by Pergande. West (N. Y. List of Insects, p. 815, 1926) lists *dubia* from New York. The type is apparently lost. The species is unrecognized.

dydas WALKER (*Tachina*), Walker's List Dipt. Insects, pt. 4, p. 748, 1849.

According to Austen (Ann. and Mag. Nat. Hist., ser. 7, vol. 19, p. 336, 1907), *dydas* Walker equals *Eutachina rustica* Meigen.

fernaldi WILLISTON (*Achaetoneura*). In Forbush and Fernald's "The Gipsy Moth," Mass. Board of Agriculture, p. 387, 1896.

Assigned to *Achaetoneura* by describer. Coquillett (Revision of N. A. Tachinidae, p. 119, 1897) correctly places this species as a synonym of *Tachina mella* Walker.

flavicauda RILEY (*Exorista*), Riley's Second Report, Insects Missouri, p. 51, 1870, reared from *Leucania unipuncta*. Townsend (Trans. Amer. Ent. Soc., vol. 18, p. 364, 1891, and Psyche, vol. 7, p. 330, 1896) refers this species to *Frontina*. Coquillett (Revision of N. A. Tachinidae, p. 84, 1897) and Aldrich (Cat. Dipt., p. 450, 1905) correctly place the species as a synonym of *Belvosia unifasciata* Desvoidy.

fulvipalpis BIGOT (*Masicera*), Ann. Ent. Soc. France, p. 263, 1888, Rocky Mountains.—BRAUER, Sitzungsbericht d. k. Akad., vol. 106, p. 340, 1897, gen. ref. from type. Unrecognized.

insularis BRAUER and BERGENSTAMM (*Prosopaea*), Zweif. Kais. Mus. Wien, pt. 5, p. 334, 1891, St. Thomas, W. I.

Placed in *Prospalaea*, new genus, by Aldrich (Ann. Ent. Soc. Amer., vol. 18, p. 111, 1925).

irrequicta WALKER (*Tachina*), Walker's List Dipt. Insects, vol. 4, p. 789, 1849.

Coquillett (Revision of N. A. Tachinidae, p. 108, 1897) recognized this species in material bred from *Papilio thoas Linnaeus* from Jacksonville, Fla. He also considered *Masicera rileyi* Williston as synonymous with it. Aldrich (Cat. Dipt., p. 463, 1905) did not agree with Coquillett, holding that *rileyi* was distinct and that Walker's species was unrecognizable.

Aldrich's view is in accord with that of the present author.

lata WIEDMANN (*Tachina*), Auss. Zweifl., vol. 2, p. 322, 1830.

Assigned to *Achaetoneura* by Brauer and Bergenstamm (Zweif. Kais. Mus. Wien, pt. 5, p. 334, 1891). Aldrich (Proc. U. S. Nat. Mus., No. 2703, vol. 72, art. 7, p. 8, 1927) has studied the type and found characters that would exclude it from *Achaetoneura*. Referred to *Frontina*.

rubentis COQUILLETT (*Achaetoneura*), Proc. Acad. Nat. Sci. Phila., p. 310, 1895.

Placed in *Frontina* by Coquillett (Revision of N. A. Tachinidae, p. 106, 1897). The different chaetotaxy, female with ventral abdominal keel armed with spines and with a sharp piercer, are characters which exclude it from *Achaetoneura*. Provisionally referred to *Lydella* by the writer.

rufifrons ROEDER (*Frontina*), Stett. Ent. Zeit., p. 346, 1885, Porto Rico.

The species is unrecognized.

rufostylata BIGOT (*Frontina*), Ann. Ent. Soc. France, p. 83, 1888, Mexico.

Aldrich (Cat. Dipt., p. 468, 1905) refers the species to *Prospherysa*.

setipes COQUILLETT (*Frontina*), Proc. U. S. National Museum, vol. 25, No. 1280, p. 112, 1902.

Provisionally placed in *Prosopalaca* Aldrich by Aldrich (Ann. Ent. Soc. Amer., vol. 18, p. 111, 1925).

sphingivora TOWNSEND (*Masicera*), Trans. Amer. Ent. Soc., vol. 19, p. 286, 1892.

Coquillett (Revision of N. A. Tachinidae, p. 108, 1897) believes that it is synonymous with *violenta* Walker. Aldrich (Cat. Dipt., p. 463, 1905) disagrees with Coquillett and makes *sphingivora* a synonym of *dubia* Williston. The type has not been seen by the writer, although, from its description, the species would fall in the *frenchii* complex.

tenthredinidarum TOWNSEND (*Masicera*), Trans. Amer. Ent. Soc., vol. 19, p. 285, 1892.

Coquillett, in errata attached to revised index to Revision of N. A. Tachinidae, refers this species to *Frontina*. Aldrich (Proc. Ent. Soc. Wash., vol. 32, 1930, p. 25) shows that it is a synonym of the European *Ptychomyia selecta* Meigen.

violenta WALKER (*Tachina*), List of Dipterous Insects, pt. 4, p. 788, 1849. Aldrich has seen the type and places it in *Tachinomyia*.

Coquillett's species is here described as *testacea*, new species.

xychus WALKER (*Ophelia*), Walker's List Dipt. Ins., vol. 4, p. 770, 1849, Jamaica.

According to Austen (Ann. and Mag. Hist., ser. 7, vol. 19, p. 332, 1907), *xychus* is a *Frontina*. The species is not recognizable from its description.

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RESTUDY OF SOME BURGESS SHALE FOSSILS

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INTRODUCTION

The following notes deal with certain of the very remarkable fossils discovered by the late C. D. Walcott in the Middle Cambrian Burgess Shale. The material examined was all collected by Walcott at the now celebrated locality "on the west slope of the ridge between Mount Field and Wapta Peak, 1 mile [1.6 km.] northeast of Burgess Pass, above Field, British Columbia." The present contribution is submitted in the belief that the forms discussed are of considerable interest to students of living invertebrate animals though they are likely to be somewhat neglected by palaeontologists on account of their isolated occurrence as fossils. The diverse systematic positions of the two forms discussed makes it desirable to present the material in two parts; it is, however, convenient to assemble all the photographs on a single plate at the end of the second contribution.

My very best thanks are due to the authorities of the United States National Museum, and in particular to Dr. Charles E. Resser, who most generously provided every facility for the study and description of the material in their charge. To Doctor Resser I am particularly grateful for the photographs which constitute Plate 1.

I am also much indebted to Prof. Alexander Petrunkevitch, of Yale University, who has freely given me access to his immense store of knowledge and to his beautiful preparations of Arthropoda; to Dr. L. A. Borradaile, of Selwyn College, Cambridge, England, who some years ago allowed me to transcribe certain parts of his valuable notebooks relating to the Arthropoda, which have been of great value in the present work; and to Miss L. Krause, artist to the Osborn Zoological Laboratory, for the trouble she has taken over the reconstruction of the animals under discussion.

I. ON OPABINIA AND RELATED PALAEOZOIC ANOSTRACA

Branchiopod Crustacea of the Burgess Shale.—Walcott (1912) described eight new genera of Branchiopoda in his collections from the Burgess Shale. Four of these genera were placed in a new

Anostracan family Opabiniidae, the remaining four were distributed among as many families of the Notostraca. These fossils have subsequently been considered by Raymond (1920), Fedotov (1924), and Henriksen (1928). The three authors have come to different conclusions on some of the forms. On the whole Henriksen's contribution is of the most value because he has been able to study new material of certain species, collected by Walcott after the publication of his original paper. Of the Notostraca only one form, *Burgessia bella*, is considered as properly placed by either Fedotov or Henriksen. Henriksen allows three of Walcott's genera of Anostraca to remain in that group, very properly removing *Leanchoilia* to the Merostomata. He considers that *Yohoia* should form the type of a new Anostracan family and that the problematic *Bidentia* is perhaps allied with *Opabinia*. Fedotov is very doubtful about *Yohoia* and *Bidentia* but all authors are unanimous that *Opabinia* is rightly placed as an Anostracan.

The present distribution of the Branchiopoda.—The Branchiopoda rival the Rotifera as the most characteristic invertebrate animals of inland waters. Very few species inhabit the sea, while the group is spread through a very wide range of fresh-water habitats. The three groups of large forms, the Anostraca, Notostraca, and Conchostraca are to-day essentially crustaceans of temporary seasonal waters, flourishing best in semidesert and steppe environments. The Cladocera, now so widespread in both seasonal and perennial waters, are probably derived from the larger "phyllopods." A very few species of Cladocera inhabit the sea, and these are for the most part neritic. It is clear that chemical conditions have played little part in restricting the Branchiopoda to inland waters. *Artemia salina* Linnaeus can tolerate a far higher salinity than that of the sea; moreover recent unpublished experiments strongly suggest that certain supposed cases of the limitation of Cladocera by chemical conditions are fallacious. The occurrence of an undoubted Anostracan in an ancient marine deposit is therefore of considerable interest to the fresh-water ecologist. Since none of the authors referred to has given entirely satisfactory descriptions of *Opabinia* it seemed desirable to reexamine the material in order to gain additional information on its structure in the hope that it would throw light on the disappearance of the Branchiopoda from the sea.

Material examined.—Walcott separated his *Opabinia* into two species, the typical *Opabinia regalis* and a doubtful species, *O.? media*. The latter, distinguished by its smaller size and lesser number of segments, is based on very poor material in which a segmental count must necessarily be very uncertain. Since no very small specimens are included in the material of *regalis* it is very probable that

the younger stages are represented by *media* which may for the present be treated as the young of the former species. Of *regalis* Walcott had four specimens of supposed males and two "females." The latter, as indicated below, are probably not rightly referred to *Opabinia*. I have examined eight specimens of *O. regalis* in which the head is sufficiently preserved to show the frontal process, two in which it is well preserved but apparently lacks the process, and numerous fragments.

OPABINIA REGALIS Walcott

Opabinia regalis WALCOTT, 1912, Smiths, Misc. Coll., vol. 57, p. 167.
Opabinia ? media WALCOTT, 1912, Smiths. Misc. Coll., vol. 57, p. 170.

Head.—The most complete indication of the structure of the head is given by the two specimens U.S.N.M. 57683 and 57684, figured by Walcott, by a dorso-ventrally compressed specimen figured here from a retouched photograph left by Walcott (pl. 1, fig. 4), and by a dorso-ventrally compressed specimen very similar to specimen 57683. All the specimens are represented by both sides of the split pieces of shale in which they are fossilized. The most conspicuous feature of the head is the large frontal process which is visible in all these specimens and in four other much less perfect ones. It consists of an elongate cylindrical process, inserted on the extreme front of the head, in the unfigured laterally compressed specimen it is bent round at the side of the head covering the ventral part of the latter; in specimen 57683 it is flexed upwards, while in the two dorso-ventrally compressed specimens it is shown squeezed out straight forward. In none of these positions is there any sign of breakage so that the process was certainly flexible. In the specimen figured from Walcott's photograph in Plate 1, Figure 4, traces of an internal cavity can be made out so that it was probably erectile, being filled with fluid as is the process of *Thamnocephalus* (Evans, 1915). In the laterally compressed specimen 57683 the process, though hard to measure on account of its flexure, is clearly less erected than in either dorso-ventrally compressed specimens. Anteriorly the process is dilated in the two latter specimens and is distinctly cleft apically. The extreme tip bears a number of large spinous projections. The whole surface of the process is somewhat wrinkled and the apical part apparently bears some very small spines arranged in irregular rings. Well preserved compound eyes are found on the dorso-ventrally compressed specimens. In the individual figured on Plate 1, Figure 4 the large dark ommatidial part is particularly clear. The ocular peduncle appears to have been very similar to that of modern Anostraca. In the laterally compressed specimen 57683 the eyes, though much broken, can also be made out, the stalks on which they are set being directly dorsally. No appendages could be found on the head by Walcott.

In specimen 57683 there is a small crack in the exo-skeleton just above the insertion of the frontal process. This crack was probably formed by the flattening of some projecting structure; traces of a small protuberance can be made out in the same position in the unfigured laterally compressed specimen. It is possible that these remains represent the point of insertion of small antennules. Alternatively these appendages may have been attached to a papilla situated behind the crack just mentioned and below the eye on specimen 57863. It is, however, quite possible that the antennules, always small in the Anostraca, have become entirely obsolete. The whole

FIGURE 1.—OPABINIA REGALIS WALCOTT. ANTERIOR END OF COTYPE (U.S.N.M. 57683); *ant.*, ANTENNA. (ABOUT × 2.5)

of the ventral posterior part of the head in specimen 57683 is probably the antenna. (Fig. 1.) This region bears a very close resemblance to the folded antenna of the female of any recent species of Anostraca, and is separated from the dorsal part of the head by a faint but definite groove. The frontal process, if homologous with that of living forms, was developed from fused internal branches of the antennae, but the latter show no other indication of having been modified as extensive secondary sexual organs. No ventral views of the head exist so the mouth parts remain unknown.

Trunk.—According to Walcott the trunk consists of 16 somites bearing foliaceous appendages. The sutures in his photograph of

specimen 57683 are much retouched. After considerable study of all the material I was unable to detect more than 15 appendage-bearing somites and believe that the first segment figured by Walcott is really part of the head and does not bear a leg.

Abdomen.—The abdomen consisting of a broad spatulate lobe is apparently divided into two parts. The larger anterior part has a concave posterior edge produced at the side into a pair of spines, between which the much smaller posterior division lies. The anus opens on the posterior part of the latter. The structure of this region is well shown in specimen 56784. (Walcott 1912, pl. 28, fig. 1.) The large anterior part is clearly a true segment; the status of the posterior part must remain doubtful.

Appendages.—Considerable diversity in appearance is exhibited by the trunk appendages of different specimens. This is probably due to the position of fossilization rather than to any actual differences implying a mixture of species. The lateral aspect of the trunk appendages can best be studied in specimen 57683. In this specimen the first 14 are flat leaflike lobes hanging down at the side of the body. (Fig. 1.) Each appendage apparently lies somewhat in advance of the segment bearing it, so that the upper anterior margin slopes obliquely upward and backward to the insertion which is marked by the remains of musculature. Walcott said that the appendages were jointed, but I can find no trace of joints, nor would such be expected in a foliaceous appendage. Attached to the outer surface he also describes "gills" and a "strongly setiferous lobe" on the distal part of the appendage. The supposed gills in Walcott's figure are marks made by irregular splitting of the shale and no trace of them is to be found either in the well-preserved anterior appendages in specimen 57683 or in other relatively perfect specimens. The anterior part of the limb is, however, somewhat dilated in the former specimen, but the convexity is not separated by any suture or joint from the limb itself. The "strongly setiferous lobe" presumably refers to the whole posterior part of the distal end of the appendage. This area in 56783 is clearly demarcated from the rest of the appendage and may represent a flabellum. It is, however, not certainly detectable in other specimens. The setae are probably illusionary; I can detect no certain setae on the external surface of any limb.

The internal edge of the foliaceous appendage carried a series of very strong thick setae. (Fig. 2*b*.) These are visible in both well-preserved dorso-ventrally compressed specimens and in various fragments. In all cases they are exposed by the breaking away of the outside flat surface of the appendage. The latter was presumably considerably curved in frontal section, the concavity being directed

backwards. When compressed the outer surface of the appendage would then cover the inner edge as is actually found in the specimens. In no case can the insertion of the setae on the inner edge of the appendage be unequivocally made out, but it is probable that there was no very unequal development of certain endites for the setae are very evenly developed throughout the whole length of the appendage.

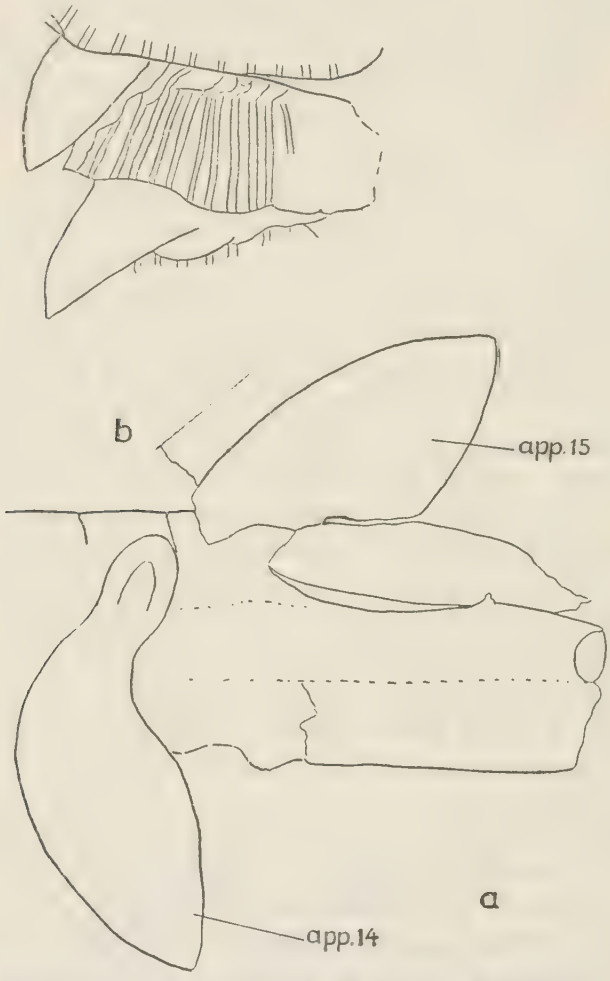

FIGURE 2.—OPABINIA REGALIS WALCOTT. *a*, POSTERIOR END OF COTYPE (U.S.N.M. 57683); *app. 14*, LEFT APPENDAGE OF FOURTEENTH TRUNK SOMITE; *app. 15*, RIGHT APPENDAGE OF FIFTEENTH TRUNK SOMITE (× 5). *b*, LEFT APPENDAGE OF SEVENTH TRUNK SOMITE OF COTYPE (U.S.N.M. 57684) (× 5)

The last pair of appendages, on the fifteenth segment, was clearly not directed ventrally in life but more laterally than those at the anterior end of the body. In specimen 56783 it consists of a flat platelike structure, the edges of which are imperfectly preserved. (Fig. 2.) The plate lies at a lower level than the rest of the

specimen, while in the very similar unfigured laterally compressed individual a comparable plate is visible lying above the specimen. In the dorso-ventrally compressed specimen 56784 no such structure can be made out; it has probably not been exposed in the splitting of the shale. The best interpretation to be placed on this appendage is that it formed, with the abdomen, a sort of tail fan. In the individual discussed below and figured on Plate 1, Figure 3, the last appendage is shown clearly on the left-hand side, lying in such a position against the abdomen. The condition of the posterior appendages, here shown as broad simple plates, indicates that there was no essential difference between the fifteenth and the other appendages. Unfortunately the condition of the anterior part of this specimen is not sufficiently good to allow the number and structure of the anterior appendages to be made out.

Internal structure.—Walcott mentions a "very beautiful specimen showing some details of the interior." This is presumably the individual figured from his photograph in Plate 1, Figure 4. The only certainly determinable structures are the alimentary canal and the obliquely arranged segmental musculature.

Supposed female of Opabinia.—Walcott described two specimens of the same general appearance as *O. regalis*, but with a reduced frontal process and with filiform caudal cerci. These specimens he believed to be the females of *Opabinia*. It is very improbable that the presence of a caudal cercus would characterize the female sex in this group so that in all probability these two specimens, which are very poorly preserved, represent an entirely different animal. It has previously been indicated that remains of eight individuals bearing a frontal process exist in the collection. In addition to these are two specimens which, though quite well preserved, are without any such organ. The better specimen of these is figured in Plate 1, Figure 3. The head ends anteriorly as a truncate lobe in front of the stalked eyes. It is possible that the process lies at a different level in the shale or has been broken, the general appearance of the specimen however is against such a supposition, and I am inclined to think that the two individuals without frontal processes represent the true female of *Opabinia regalis*.

Comparison with living Anostraca.—In discussing the relationship of *Opabinia* with modern Anostraca the following resemblances may first be noted:

1. Absence of a carapace.

This characterizes two groups of Branchiopoda, the Anostraca and the Lipostraca. From the solitary representative of the latter

group, *Lepidocaris* (Scourfield 1926), *Opabinia* differs in numerous characters as mentioned below.

2. General form and size.

The general appearance of *Opabinia* as shown particularly in the laterally compressed specimens and indicated in the conjectural restoration (fig. 3*a*) must have been very close to that of modern Anostraca. In size it was larger than the majority of modern species, but female specimens of *Branchinecta ferox* (Milne Edwards) may reach 70 mm. in length (Daday 1910), which size is almost identical with that of the best preserved female *Opabinia regalis*. The large size of all the Anostraca is in striking contrast to that of the minute Lipostracan *Lepidocaris*.

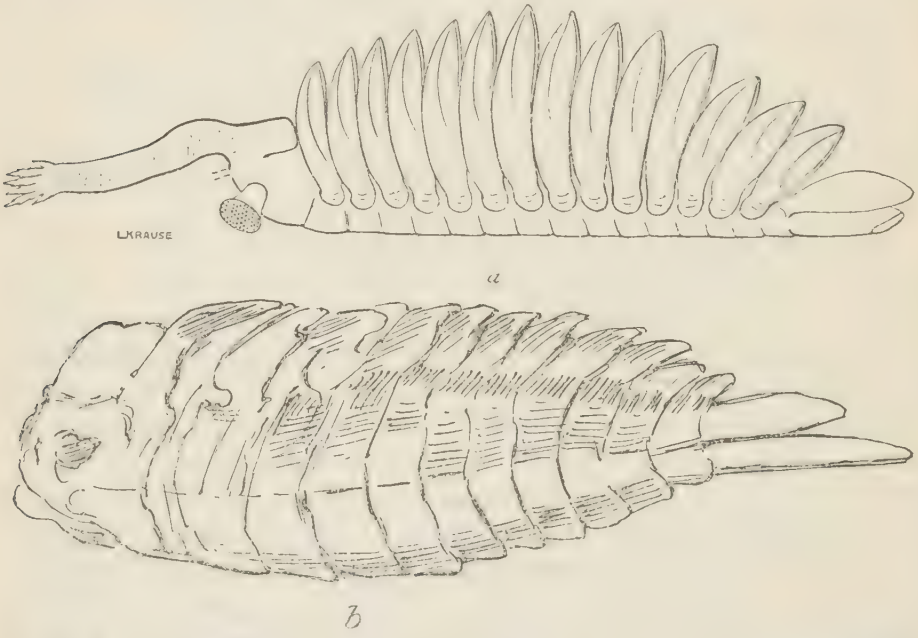

FIGURE 3.—PALAEANOSTRACA. *a*, OPABINIA REGALIS WALCOTT, CONJECTURAL RESTORATION. (ABOUT × 1¼.) *b*, ROCHDALIA PARKERI H. WOODWARD × 4 (AFTER WOODWARD, BY COURTESY OF THE EDITOR OF THE GEOLOGICAL MAGAZINE.)

3. The presence of pedunculate eyes.

This is the most diagnostic character of the Anostraca among the orders of Branchiopoda and is amply fulfilled by *Opabinia*. No eyes are known in *Lepidocaris*, while the other orders all have sessile eyes.

4. The position of the antenna and the probable reduction of the antennule.

If these structures have been rightly interpreted *Opabinia* more closely resumbles the Anostraca than any other group.

5. The nearly uniform series of foliaceous trunk limbs .

This condition is characteristic of most of the "phyllopod" Branchiopoda.

6. The presence of a frontal process which was probably confined to the male.

The frontal process is developed from the fused internal or frontal appendages of the antennae in the males of various living Anostracans (*Branchinella*, *Dendrocephalus*, *Thamnocephalus*). The structure in *Opabinia* though differing in detail from that found in these recent forms is quite comparable in position and general structure.

These characters, most of which have been discussed very briefly by previous authors, clearly indicate that *Opabinia* is rightly placed in the Anostraca. Considerable differences are, however, apparent when a more detailed comparison is made.

1. The number of body segments in *Opabinia*, at most 17, is less than that found in any of the living Anostraca, which always have at least 19.

2. The number of appendage bearing segments, 15 in all, is on the other hand greater than that found in any living forms save the Polyartemiidae, and the number of postpedigerous segments, one or two, is strikingly less than the 8 or 9 of all modern forms. Calman (1909) argues that the condition of the Polyartemiidae is secondary because there is a postgenital abdomen of 8 segments comparable to that of the other families in the group. The number of pedigerous segments in this family is in fact variable, being 17 in *Polyartemiella* and 19 in *Polyartemia* so that it is not at all unlikely that addition of segments has occurred here, as it certainly has in the Notostraca. If we assume that the primitive number of segments in the Anostraca is that retained by the majority of modern species, the ancestral form presumably had 19 or 20 pedigerous segments. This number accords well with what is known of the primitive numbers in other groups of Crustacea, moreover, *Lepidocaris*, which is in some respects the most archaic known crustacean, had 18, of which the posterior one was probably compounded of two or three somites. It would appear, therefore, very probable that *Opabinia* has a slightly reduced number of body segments. The condition of the postpedigerous portion suggests that, as in *Lepidocaris*, reduction was occurring from behind.

3. The detailed structure of the foliaceous appendage was apparently different to what is found in living *Anostraca*. If branchiae were really absent as seems almost certain, the appendages of *Opabinia* show some resemblance to the anterior members of the series of *Lepidocaris* which also lack these structures. The modification of the posterior appendage to form part of an incipient tail fan is unique among the Anostraca.

4. The absence of a caudal furca in *Opabinia* may perhaps be correlated with the lateral position of the posterior appendages. It is not impossible, as has been indicated above, that the whole post

pedigerous part of the body is reduced in *Opabinia*. In living Anostraca the furca is absent only in the extreme form of *Artemia salina* var *köppeniana* (S. Fischer) and in the very specialized genus *Thamnocephalus*.

5. The form of the frontal process, though comparable in general with that of certain modern genera has a much longer unpaired proximal region and a correspondingly shorter distal paired portion.

All of these differences with the doubtful exception of the number and nature of the foliaceous appendages point to *Opabinia* being considerably less generalised than the modern Anostraca.

Other fossil Anostraca.—Fossil Anostraca are exceedingly rare. Apart from the Burgess Shale forms only three species appear to be recorded. The Eocene *Artemia vectensis* (H. Woodward)[1] shows us a species essentially like modern forms at the beginning of the Tertiary. Apart from this form no member of the group is known between Palaeozoic and modern times. Two species are recorded from the Coal Measures of Europe. *Branchipusites anthracinus* Goldenberg (1875) from Saarbrücken is so fragmentary, being based on the middle portion of a body with supposed foliaceous appendages, that its Anostracan nature is open to doubt. *Rochdalia parkeri* H. Woodward (1913) based on a whole individual from the Middle Coal Measures of Sparth Bottoms, Rochdale, Lancashire, is fairly well preserved and of great interest in the present discussion. The specimen was fossilised in a small clay iron stone nodule. It is 28 mm. long and consists of a head, 11 pedigerous segments that are clearly defined, and a "telson" with a "lateral plate." The head apparently bears a pedunculate eye; on its ventral surface lies a structure which Woodward terms the "proboscis" and which presumably represents an unmodified antenna. In Woodward's figure very definite indications of a segment bearing an appendage lies between the head and the first of his segments, so it is possible that there are really 12 pedigerous segments. The appendages are figured as of the simplest foliaceous type, traces of the attachment of branchiae are said to exist. The misnamed "telson" probably represents the last pedigerous segment bearing a laterally placed appendage which Woodward terms the "lateral plate"; possibly one or more post-pedigerous segments have become fused into this segment. The general appearance suggests strongly that considerable reduction has occurred in the segmentation. In so far as *Rochdalia* can be elucidated it is clearly closer to *Opabinia* than to any living

[1] This species was described by Woodward (1879) as *Branchipodites vectensis*. Daday (1910) has with good reason referred it to *Artemia*, but it seems highly improbable that the modern species *salina* is identical with the Eocene representative of the genus so that Woodward's specific name should stand until the two species are conclusively proved to be identical.

Anostracan. If *Opabinia* is derived from a primitive Anostracan with a few postpedigerous segments, most of which have been lost posteriorly, *Rochdalia* seems to have carried the reduction still further.

Of the remaining Burgess Shale species considered as Anostraca by Henriksen, namely *Yohoia tenuis* and *Bidentia difficilis*, both are clearly much more remote from the living Anostraca than is *Opabinia*. Both genera have but 12 post-cephalic segments, so exceeding the latter in their reduction of the body segmentation. *Bidentia* is very inadequately known from Walcott's account, and *Yohoia* is almost equally in need of further study. The pedunculate eyes of the latter probably indicate its anostracan affinities, though as Henriksen points out the genus differs from all known Anostraca in the peculiar pleural expansions of its first eight segments. It is worth pointing out, however, that the Lipostracan *Lepidocaris* has very distinct jointed pleura. Henriksen places *Yohoia* in a new family, the Yohoidae; if *Bidentia* is ever better known the same course will probably be necessary. For the present we may conclude that these forms represented highly specialized and aberrant marine Anostraca.

Ecological Considerations.—As has been pointed out the modern Branchiopoda are essentially organisms of seasonal waters or have clearly been derived from such. The marine Anostraca of the early Paleozoic represent a more specialized series of morphological types than the living representatives of the order. *Opabinia* with its fan-like arrangement of the posterior appendages must have presented a more caridoid appearance than a modern Anostracan though was probably sufficiently like the latter in form to have swum dorsal side downward. Moreover, if *Yohoia* is rightly referred to the group there is definite evidence from the position in which the latter animal is fossilized (Walcott, 1912, pl. 29, figs. 7, 8, and 12) that the characteristic flexure of the body of the higher Crustacea had developed in the Anostraca. It is clear, therefore, that at a remote period a development of the Anostraca occurred in the sea giving forms which were ecologically comparable to various types of higher Crustacea that have replaced them. This group of marine Anostraca characterized by a reduction in the segmentation probably invaded inland waters, for *Rochdalia* was presumably a fresh-water form. The morphologically primitive modern Anostraca have become specialized in their life history for existence in dry regions and have suffered no competition from similar developments by more advanced Crustacea of other groups that have replaced the marine branch of the order. It is highly probable that other living orders of Branchiopoda shared in the marine development of the group in early

Paleozoic times. *Burgessia bella* Walcott (1912) is referred by both Walcott and Henriksen to the Notostraca; my own reexamination of the material adds nothing to their account. This form is of particular interest as its internal organs can be seen in great detail. If a modern Notostracan were similarly fossilised the most prominent internal organs visible would undoubtedly be the large maxillary glands in the carapace of which no trace can be seen in *Burgessia*. Their absence in a marine form is in accordance with what is found in other Crustacea, where "excretory" organs are better developed in fresh-water forms than in marine, and function as regulators of water content and osmotic pressure (Schlieper, 1929).

Systematic Position.—In order to express the considerable differences existing between modern species of Anostraca and *Opabinia* and its ally *Rochdalia*, the order may be conveniently divided into two suborders in the following way:

Suborder 1. EUANOSTRACA

Anostraca with 19 or more segments of which at least 11 are pedigerous, followed by a postpedigerous, postgenital, region of at least 8 segments. Trunk appendages with branchiae and flabellum. Caudal furca present (except in *Thamnocephalus*) median frontal process, if developed, strongly bifurcate.

Family [2] 1, Polyartemidae Simon, Recent, Circumarctic.

Family 2, Artemidae Grochowski, Recent and Eocene, Cosmopolitan.

Family 3, Branchipodidae Daday, Recent, Old World.

Family 4, Chirocephalidae Daday, Recent, Old World and North America.

Family 5, Streptocephalidae Daday, Recent, Old World and North America.

Suborder 2. PALAEANOSTRACA

Anostraca with not more than 17 segments, of which 11–15 are pedigerous followed by a very reduced postpedigerous region. Trunk appendages apparently deficient in exites. Caudal furca absent in known forms.

Family 1, Opabinidae Walcott.

Fifteen pedigerous segments followed by a postpedigerous portion divided into two parts, of which at least the anterior one is presumably segmental. Frontal process bifurcated only at the apex.

Type *Opabinia* Walcott with one certain species, *O. regalis* Walcott, Middle Cambrian, British Columbia.

[2] Daday (1910) and Barnard (1929).

Family 2, Rochdalidae, new family.

Twelve pedigerous segments with no separate postpedigerous region distinguishable.

Type *Rochdalia* H. Woodward with one species *R. parkeri* H. Woodward, Coal Measures, England.

Incertae sedis.

Family Yohoidae Henriksen.

Type *Yohoia* Walcott, with a single certain species *Yohoia tenuis* Walcott, Middle Cambrian, British Columbia.

Family?

Bidentia difficilis Walcott, Middle Cambrian, British Columbia.

Family?

Branchipusites anthracinus Goldenberg. Coal Measures, South Germany.

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2. ON THE ONYCHOPHORAN AYSHEAIA PEDUNCULATA WALCOTT

In his contribution dealing with the extraordinary annelid fauna of the Burgess Shale, Walcott (1911) described among other new forms a unique specimen which he named *Aysheaia pedunculata*, placing it as a polychaet in a new family the Aysheaidae. The remarkable resemblance of this fossil, as illustrated by Walcott, to the living Onychophora could not fail to impress itself on anyone familiar with the recent members of the group. *Aysheaia* has therefore been placed in or near the Onychophora by various authors since it was first made known (Brues 1923, Handlirsch, 1925, 1926, Walton, 1927), but no further details of its structure have hitherto been published.

While examining the specimens of *Opabinia* described above, it seemed probable that a reinvestigation of *Aysheaia* would be profitable in the hope that any relationship it bears to the living Onychophora might be more certainly determined.

Type specimen.—The type of *Aysheaia pedunculata* consists of a very distinct worm-like fossil, 31 mm. long, lying on a piece of shale near a well preserved example of the problematic worm *Ottoia prolifica* Walcott. On the same slab are fragmentary remains of *Marrella* and other animals. A reverse specimen of that part of the slab bearing the type of *Aysheaia* also exists in the collection. The left side of the worm is probably perfect and shows at least 10 pairs of appendages. The posterior region on this side is rather confused, but it is highly probable that an eleventh appendage is lying close up against the tenth which is otherwise unaccountably thick. Most of the right margin behind the fifth appendage is missing. Walcott describes the anterior end of the animal as forming a head which is said to consist of " a central narrow longitudinal section—a rounded lobe on each side of its posterior half that suggests large eyes: the anterior end appears to have short slender tentacles projecting forward." On examining the type I was suprised to find that this head is very ill defined, and composed of a material of different texture to that of the rest of the fossil. The boundaries of the parts are very obscure, and seeing that there is absolutely no trace of such a structure in any of the undescribed material, much of which is in very perfect condition, it is probably either a piece of prolapsed alimentary canal, or a decayed fragment of one of the very numerous organisms associated with *Aysheaia* in the same slab of shale. It is unnecessary to describe the other features of this specimen here as their true nature will become apparent when viewed in the light of the better preserved additional material.

Additional specimens of Aysheaia pedunculata.—The collections made by Walcott subsequent to the publication of his preliminary

paper contain eight other specimens of *Aysheaia* from the same horizon, which may be enumerated as follows:

(*a*) Length 25 mm., dorso-ventrally compressed, most of right side missing; 11 appendages clear on right, posterior appendage of

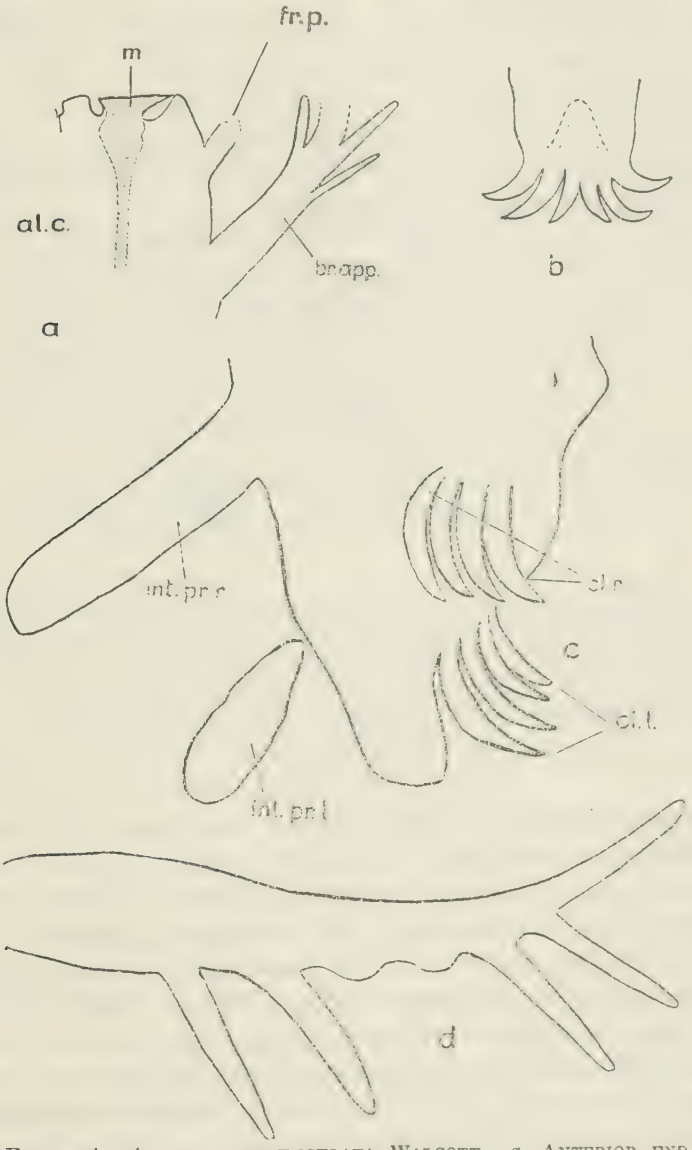

FIGURE 4.—AYSHEAIA PEDUNCULATA WALCOTT. *a*, ANTERIOR END OF SPECIMEN *a*; *m.*, MOUTH; *al. c.*, ALIMENTARY CANAL; *fr. p.*, FRONTAL PAPILLA; *br. app.*, BRANCHED APPENDAGE (× 10). *b*, FOURTH RIGHT LEG OF SPECIMEN *a* SHOWING SIX CLAWS AND SUB-APICAL TRIANGULAR AREA (× 50). *c*, SUPERIMPOSED POSTERIOR LEGS OF SPECIMEN *a*; *cl. r.*, CLAWS OF RIGHT LEG; *cl. l.*, CLAWS OF LEFT LEG; *int. pr. r.*, INTERNAL PROCESS OF RIGHT LEG; *int. pr. l.*, SUPPOSED INTERNAL PROCESS OF LEFT LEG (× 50). *d*, BRANCHED APPENDAGE OF SPECIMEN *b* (× 25)

left apparently lying close under its fellow, and visible on the right-hand side. (Fig. 4, *a–c*.)

(*b*) Length 45 mm., laterally compressed, portions missing from the mid posterior region. Eleven appendages on right, indications

of the left posterior appendage by the side of the right. (pl. 1, fig. 2 and fig. 4*d*.)

(*c*) Length about 50 mm., very imperfect and curled up. 8 appendages clearly defined.

(*d*) Length about 12 mm., a small curled specimen poorly preserved with at least 9 appendages.

(*e*) Posterior fragment, 24 mm., 8 appendages. (Pl. 1, fig. 1.)

(*f*) Length 28 mm., 10 or 11 appendages.

(*g*) Length about 25 mm., curled; at least 9 appendages.

(*h*) Length 14.5 mm., 11 appendages.

Size and number of segments.—From the above list it is clear that *Aysheaia* reached a size of about 50 mm., that the best preserved specimens show 11 segments bearing conspicuous appendages, and that this number is the same in both small (14.5 mm.) and large (45 mm.) animals. The detailed structure of the animal is best indicated in the two specimens designated as (*a*) and (*b*), the latter being illustrated in Plate 1, Figure 2.

Body wall.—The dorsal edge of (*b*) shows a row of papillae compressed sideways, representing the most dorsal papillae of a

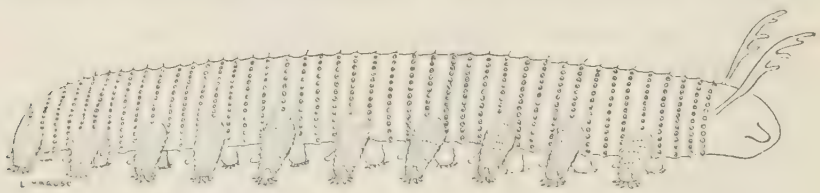

FIGURE 5.—AYSHEAIA PEDUNCULATA WALCOTT, CONJECTURAL RESTORATION

series of transverse rows which can be made out in all the specimens. Except on the dorsal margin of (*b*) the papillae are chiefly represented by small apical pits which probably each bore a minute seta as in modern Onychophora. At least 4 papillae are found dorsal to the gut on the right side of (*b*), so that the upper half of each ring had at least 8. Walcott made out 13 in a row on the type, probably the complete annulus consisted of 14 or more. Four annuli appear to correspond to each appendage in the trunk region, and so to each segment; there are, moreover, 4 annuli of papillae on the anterior end of (*b*), which clearly correspond to the segment of the branched appendage.

Legs.—The legs appear in all the specimens as the flattened remains of slightly tapering truncate cylinders. They are annulated, as are those of recent Onychophora, the best preserved show at least 8 annulations. Each leg ended in a group of claws; on the fourth right leg of (*a*) 6 claws can be distinguished, 3 turned forward and 3 backward. (Fig. 4*b*.) On the other legs only 3, 4, or 5 claws can be found. In (*b*) the claws are all turned backwards; it is probable

that in life they were directed posteriorly, 3 a little inward and 3 a little outward, and that the apex of the leg figured is somewhat twisted. The apices of the legs of (*b*) show traces of a central structure represented by a minute dark longitudinal elongate spot, a similar more triangular area can be seen (fig. 4*b*) in the fourth right leg of (*a*). These areas of dark material are very indefinite, but probably represent a similarly placed triangular region free from large papillae, situated above the foot in modern Onychophora, as *Peripatopsis capensis* (Grube). From the side of some legs, notably the third left of the type (Walcott, 1911, pl. 23, fig. 9), and the posterior pair (fig. 4*c*) of (*a*) a spurlike elongation can be seen lying as if it was projecting from the internal surface of the leg, pointing forward in the former specimen, backward in the latter. These structures are presumably the straight setae of Walcott, the claws being his hooked setae. They are, however, not composed of the whitish material into which the claws have been transformed, but are fossilized exactly like the rest of the body and therefore were probably soft walled. Since they are found on both third and last legs they presumably occurred on all the legs but were hidden during fossilization. The 10 posterior appendages of *Aysheaia pedunculata* therefore consisted of wide slightly tapering annulated limbs bearing six apical claws and possibly other terminal structures, and a ventral or internal organ to which the name "internal process" may be conveniently applied. The bases of the unexposed legs on the left side of (*b*) are presumably represented by the swellings in the middle of the body above each leg.

Branched appendage.—The segment immediately in front of the first pair of legs carries a pair of appendages which in the dorsoventrally compressed specimens lie in an exactly comparable position to the legs. In specimen (*b*), however, these appendages seen from the side, are apparently directed forward and downward on the right, backward and upward on the left. The head is probably twisted, but there can be little doubt that the appendages in question were inserted at a somewhat higher level on the body wall than were the following 10 pairs of legs. The position of fossilization in (*b*), moreover, strongly suggests that they were very mobile and could take up a variety of positions. This pair of appendages differs radically from the legs in not possessing claws and in being furnished with a number of branches or processes. In the left-hand branched appendage of (*b*) two apical and two basal processes are distinguishable (fig. 4*d*), and there are indications of two papillae in the middle region. In the left-hand appendage of (*a*) and in that of the type three processes at least are present. In (*b*) all lie on the anterior side of the appendage, in (*a*) two

are posterior. In all probability they did not arise directly one above the other; the axis of the appendage is doubtless somewhat twisted in some of the specimens.

Head and associated structures.—None of the hitherto undescribed specimens show any of the head structures described by Walcott. Since (*a*) and (*b*) are very perfect it seems best, for reasons already given, to disregard to problematic "head." The actual head—that is, that part of the animal in front of the branched appendages—seems to have had an irregularly truncated margin which probably bore papillae. On the right-hand side of the head in (*a*) a short appendage or frontal papilla of uncertain structure can be made out. (Fig. 4 (*a*) *fr. p.*) No horny jaws can be detected, though the fine preservation of the claws in this specimen makes it almost certain that they would have been detectable had they existed. The mouth seems to have been terminal, and a slightly dilated buccal cavity is indicated.

Internal organs.—The unbranched alimentary canal containing dark material can be seen almost throughout the whole length of the body in several specimens. The position of the anus can not be determined.

Habitat.—There can be no doubt that the deposit in which *Aysheaia* was fossilised is of marine origin. The evidence afforded by the whole of the associated fauna points in this direction. Moreover, the presence of no less than nine specimens in the collection indicates that the organism was not a casual straggler washed in from the land, but a true member of the marine association with which it is found. Two morphological points are of interest in this connection.

1. The characteristic Onychophoran form of the body was apparently as strikingly developed in the Middle Cambrian marine form under consideration as in the terrestrial Peripatidae and Peripatopsidae of to-day. Many zoologists have objected to the division of the living Onychophora into two families with many genera on the grounds that the whole assemblage is a very uniform one in spite of considerable differences in detail. In *Aysheaia* we have a form living under entirely different ecological conditions from those of the modern species, and at a very remote time, yet having an external appearance, which in life must have been extraordinarily similar to that of the living representatives of the group. The considerable structural differences which do occur are only manifest when a minute examination is made. Presumably the internal structure of the body of *Aysheaia* presented differences of great importance; tracheae are hardly likely to have been present in a form that we may reasonably assume was primitively marine.

2. The position of the mouth deserves a passing mention. In the modern Onychophora the mouth lies in a ventrally situated oral cup. The ventral position of the mouth is clearly of considerable value in feeding on solid material, particularly in a terrestrial animal. Terminal mouths may persist or be developed in burrowing forms, but outside the polychaet annelids are uncommon among the higher invertebrates. It is, therefore, of interest that *Aysheaia* had apparently acquired ambulatory limbs while still retaining a terminal mouth.

Relationship to modern Onychophora.—The strongest evidence in favor of placing *Aysheaia* in the Onychophora is that afforded by the nature and appearance of the body wall and form and disposition of the appendages. From the modern Onychophora *Aysheaia* differs in the following ways.

1. The smaller number of segments in *Aysheaia.*

No modern Onychophoran has less than 14 segments bearing clawed legs. This corresponds to a total of 17 segments. In *Aysheaia* there are 10 segments bearing clawed legs and probably two more, making a total of 12.

2. The small number of annuli to each segment.

Aysheaia has 4 annuli of papillae, the modern species all have more than 12.

3. The large number of claws on the walking legs.

All modern Onychophora have two claws on each trunk appendage, supported by a complex foot. In *Aysheaia* there are six claws and the foot was presumably much less elaborate. In the embryo of *Peripatus corradoi* Camerano, Bouvier (1907, p. 38, fig. 43) figures each claw as covered with a cuticular layer, afterwards shed, bearing a number of large denticles. It is highly probable that the claws in adult Onychophora are compound, each representing one of the two groups of three in *Aysheaia.*

4. The internal process of the trunk appendages.

This structure may possibly be homologous with the eversible coxal vesicles of many modern Onychophora, but would seem to lie more distally. The proximal portion is very probably covered by the base of the leg in all the specimens in which the process is shown. The internal process may well have been respiratory; the possession of a soft lobe or spur on the leg would seem more in accordance with an aquatic than a terrestrial habitat, whatever its function.

5. The terminal mouth.

This difference has already been discussed.

6. The structure and arrangement of the anterior appendages.

The interpretation of the head of *Aysheaia* is somewhat speculative and is treated at length below.

The first two differences are difficult to evaluate. Various species of Peripatopsidae approach nearer to *Aysheaia* in these respects more than do the Peripatidae, but there is no evidence that the Peripatopsidae are primitive in this. From a general point of view it is more reasonable to suppose that the small number of segments, if not that of the annuli, is a specialized reduction rather than a primitive character in *Aysheaia*. The greater number of claws may be reasonably regarded as primitive and so may the internal appendage on the legs, particularly if it is correlated with a marine habitat or is homologous with the coxal vesicles which are found only in primitive Onychophora and tend to undergo a progressive reduction. If the interpretation of the head given below be regarded as correct *Aysheaia* is much more primitive in this respect than any living Onychophoran.

Head of Aysheaia.—In the recent Onychophora there are three appendages anterior to the legs which, being considerably modified, may be considered as defining the head in the adult. These three appendages, the antennae, the jaws, and the slime papillae, are usually regarded, following the classical work of Sedgwick (1885–8) as belonging to the first three mesoblastic somites, it being supposed that no reduction in the segmentation has occurred at the anterior end of the animal. The somites from which these appendages develop are originally all postoral, the first later moves forward to form the preoral lobes from which the antennae arise. The second and third appendages, which are postoral throughout development, show certain characters which make it reasonably probable that they are derived from legs of the same type as the trunk legs of the adult. Thus the jaws are comparable to legs in which the main axis is very reduced and the claws hypertrophied, while the slime papillae may be regarded as footless legs with greatly hypertrophied crural glands. The antennae differ from the succeeding appendages in exhibiting no trace of an origin from legs and in originating more dorsally than any of the rest of the series. Holmgren (1916) in his great work on the Arthropod brain, homologises with great certainty the antennae of the Onychophora with the palps of the Polychaets. Lying in front of the palps in the Polychaets are prostomial "antennae" or "tentacles," which are variously developed and may be median or paired. These tentacles are innervated by a nerve which has the same relations to the brain as the *nervus tegumentarius* in the Onychophora. In the embryos of some Peripatidae, as *Peripatus edwardsi* Blanchard, described by Kennel (1885) and *Eoperipatus weldoni* Evans investigated by Evans (1901), indications are found of frontal organs which presumably represent the annelid tentacles, lost

in all adult living Onychophora. The anterodorsal region of the brain of the Polychaets, bearing eyes, tentacles, nuchal organ, etc., is of multiple origin, though strictly comparable with the same region in the Onychophora. It is still a matter of debate whether its various components are to be regarded as somites or as presegmental; still less can we determine whether the frontal organs of the embryos of Peripatidae are serially homologous with succeeding appendages. A discussion of the apparent segmentation of this region is outside the scope of the present paper for which purpose it seems best to consider only the appendages, no other indications of segmentation being preserved in the fossils under consideration.[3] If we are to give any weight whatever to a phylogenetic interpretation of embryology, we may conclude that at some stage in their ancestry the modern Onychophora passed through a stage in which the head bore a pair of postoral antennae, and that these were preceded by some sort of tentacle or frontal organ and succeeded by a series of uniform trunk legs bearing claws and crural glands as in the modern forms.

The following speculative interpretation of the head of *Aysheaia* fits well into the scheme derived from the embryological findings. It has already been indicated that the branched appendage, as shown in the laterally compressed specimen (*b*), lies at a rather higher level than the succeeding members of the series of appendages. This fact alone tends to indicate that it is homologous with the antenna of the modern Onychophora in spite of its less anterior and clearly postoral position. Like the antennae, moreover, it is structurally dissimilar to the succeeding appendanges and lacks claws. It is, therefore, within the limits of justifiable speculation to equate the two organs. Posterior to the branched appendage of *Aysheaia* lies a uniform series of legs. It has, however, been pointed out that such evidence as is available strongly suggests that the two appendages succeeding the antenna of modern Onychophora were at some stage similar to the other legs. In front of the branched appendages in specimen (*a*) lies a small papilliform projection which was probably tactile or trophic. If the above speculation is sound we can regard this as homologous with the frontal organ of the embryo of the Peripatidae. It is to be noted that there is every probability in favour of an Onychophoran with a terminal mouth having a very uncephalized anterior end; moreover, the segments are relatively long throughout *Aysheaia*, so that every opportunity is

[3] Through the kindness of Prof. Alexander Petrunkevitch I have been able to examine his very fine collection of serial sections of the heads of West Indian species of *Peripatus*. The brain in these forms seems to be substantially like that of *Peripatopsis capensis* (Grube) described by Holmgren, and I can add nothing of importance to the conclusions of the latter worker.

given for a diagrammatic representation of the fundamental structure in the adult animal. The conditions may be presented schematically in the following way:

Peripatus:	*Aysheaia:*
Frontal organ (embryonic).	Frontal papilla.
Antenna.	Branched appendage.
Jaw.	1st trunk leg.
Slime papilla.	2nd trunk leg.
1st trunk leg.	3rd trunk leg.

Relationships to other forms.—*Aysheaia* does not indicate any relationship between the Arthropoda and Onychophora; it merely indicates what was the general structure of the oldest members of the latter group and emphasizes its isolation. The six setalike claws alone serve to bring the Onychophora nearer to the existing polychaets, and if the Onychaphora had a polychaet origin it must have been in the very remote past from some extremely generalized ancestor. It is clear that the general form of the group is not correlated with terrestrial life. The recent discovery of *Xenusion auerswaldae* Pompeckj in supposedly Algonkian rocks suggests that segmented animals with annulated uniramous appendages at one time played a large part in the earth's fauna. Heymons (1928), indeed, in discussing *Xenusion*, suggests that the modern Onychophora, Tardigrada, and Pentastomida represent merely the relics of an important palaeozoic assemblage of animals. *Aysheaia* gives us some idea of the marine ancestors of one of the few surviving members of that fauna.

Systematic position.—It is becoming clear to most investigators of the Arthropoda that the Onychophora, in spite of their tracheal respiration and their reduced coelom and its corollaries, are misplaced in the Arthropoda. In Kükenthal and Krumbach's Handbuch, the most authoritative survey of the Animal Kingdom yet published, the Onychophora and Arthropoda are separated, and it is probable that such a course will be adopted generally in the future. The most rational course seems to be to follow Lankester in the classification used in his Treatise (1900) and include the arthropods and annelids in one phylum Appendiculata, or to revive the old Cuvierian group Articulata as has been done by various authors.

The Arthropoda, Onychophora, and Annelida may then be considered as subphyla. Possibly this rank also should be given to some of the "Stelenchopodous" groups and to *Xenusion*. For the present purpose the following scheme may be adopted.

Phylum ARTICULATA

Triploblastic metamerically segmented animals, with more than three segments, skeleton primarily ectodermal, mouth and anus both may be derived from blastopore.

(*a*) Subphylum ANNELIDA
(*b*) Subphylum and class ONYCHOPHORA

Articulates with cylindrical leglike walking appendages arranged segmentally and armed with terminal claws; body wall soft, muscular, indistinctly segmented and annulated with rings of papillae; in recent forms coelome reduced, heart ostiate, cilia confined to generative ducts.

Order 1. PROTONYCHOPHORA

Extinct marine Onychophora with a terminal mouth, a frontal papilla and clawless branched appendage followed by a series of legs bearing six claws.

Family Aysheaidae Walcott. Middle Cambrian. British Columbia.

Order 2. EUONYCHOPHORA

Terrestrial Onychophora with a tracheal respiratory system. First three somites bearing preoral antennae and two postoral modified legs which form jaws and slime papillae, frontal organs vestigial in embryo. Trunk legs with a complex foot and two claws.

Family Peripatopsidae Bouvier; recent; temperate southern hemisphere.

Family Peripatidae Evans; recent circumtropical.

(*c*) Subphylum ARTHROPODA

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DESCRIPTION OF PLATE

FIGURE 1. *Aysheaia pedunculata* Walcott, specimen *c*. (× 1½).
2. *Aysheaia pedunculata* Walcott, specimen *b*. (× 1½).
3. *Opabinia regalis* Walcott, supposed female (× 1½).
4. *Opabinia regalis* Walcott, supposed male (× 1½).

Figures 1 and 4 are from retouched photographs left unpublished by the late Dr. C. D. Walcott; Figures 2 and 3 from unretouched photographs prepared under the direction of Dr. C. E. Resser.

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AYSHEAIA PEDUNCULATA AND OPABINIA REGALIS

FOR EXPLANATION OF PLATE SEE PAGE 24

NOTES ON THE TYPES OF AMERICAN TWO-WINGED FLIES OF THE GENUS SARCOPHAGA AND A FEW RELATED FORMS, DESCRIBED BY THE EARLY AUTHORS.

By J. M. Aldrich

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The genus *Sarcophaga*, in the wide sense, includes many species from all parts of the world. In the writer's Catalogue of North American Diptera [1] 104 species are listed; and in Townsend's Catalogue of the Described Species of South American Calyptrate Muscidae [2] there are 78 more, including the allied genus *Sarcophagula*,—a total of 182 species from North and South America. These descriptions were all drawn up before the significance of the male genitalia in distinguishing the species had been ascertained, and it is almost impossible to identify any of the species without seeing the original specimens. These as far as preserved are with less than a dozen exceptions all in European museums. The writer, in revising the North American *Sarcophagas* [3] was obliged to omit nearly all of them from consideration, not being able to see the types. Later a few were borrowed from the Vienna Natural History Museum for examination. In 1929 I was detailed by the United States National Museum to visit several of the important European museums for the purpose of examining types of American Diptera, and in the course of the work was able to see most of the American types of *Sarcophaga*. The present paper is the result of this study.

I am indebted to the authorities of the Naturhistorisches Museum in Vienna; the British Museum of Natural History in London; the Naturhistoriska Riksmuseum in Stockholm; the Universitetets Zoologiske Museum in Copenhagen; the Musée National d'Histoire Naturelle in Paris, for the privilege of examing material. Mr. J. E. Collin, Newmarket, England, has in his private collection important

[1] Smiths. Misc. Coll., vol. 46, No. 1444, 1905.

[2] Annals New York Acad. Sci., vol. 7, 1892.

[3] Sarcophaga and Allies in North America by J. M. Aldrich, La Fayette, Ind., 1916, 302 pages and 16 plates.

type material of Macquart, which he generously placed at my disposal.

I was allowed to spread the genitalia of material in Mr. Collin's collection, and in the numerous species in the British Museum, as well as in those received from Vienna.

Dr. Elle Franz, of the Senckenberg Museum, Frankfort on the Main, kindly furnished a list of the types of Wiedemann's *Sarcophagas* now represented in that institution (*phoenicurus*, *calida*, *surinamensis*); unfortunately only one specimen of each exists, which under the rules can not be loaned.

I was unable to learn the location of any of Rondani's types in the genus *Sarcophaga*, several inquiries eliciting no response.

In reporting these studies, it seems advisable to list all the species of the early authors, although not all of them have been examined.

In general, no attempt is here made to divide the old genus *Sarcophaga* into smaller genera, although a few recently proposed genera are mentioned, and others are referred to as groups, leaving their final status for future determination. The present purpose is best served by trying to make the species identifiable, without going very far into the question of subdivision, which would greatly complicate this paper. The genus in the old sense is a very recognizable one, and nearly all the species here mentioned were originally referred to it.

Mr. David G. Hall kindly offered to prepare pen sketches from my penciled ones in my notes, and I am greatly indebted to him for making as good figures as the circumstances permitted. I only regret that he could not draw them from the specimens.

Dr. Harold Morrison, in charge of taxonomic investigations for the Bureau of Entomology, kindly offered the services of Mrs. Eleanor Carlin, of his staff, to make drawings of genitalia in the species received from Vienna too late to send to Mr. Hall. She made all the figures of Plate 3.

SPECIES OF FABRICUS

Musca occidua, Entomologia Systematica, vol. 4, 1794, p. 315; Systema Antliatorum, 1805, p. 288.—Wiedemann, Auss. Zweif., vol. 2, 1830, p. 368 (*Sarcophaga*).

Two females in the Zoological Museum, Copenhagen, are in accordance with the current understanding of the species,[4] but are apparently not types. The species belongs to the genus *Sarcophagula* Van der Wulp, and has many synonyms.

Musca gulo, Syst. Antl., 1805, p. 283 (*Musca*).

One female, South America, said to be in the Sehestedt collection, now a part of the Zoological Museum, Copenhagen. The type is

[4] Aldrich, Sarcophaga and Allies, 1916, p. 40.

still in fair condition, and proves to be the same as my *Sarcophaga wiedemanni*[5]; Townsend[6] has proposed the new genus *Paraphrissopodia* with designated type *Peckia lamanensis* Robineau-Desvoidy, which is again the same species (at least in Townsend's sense, but the type is lost). Townsend saw the type of *gulo* in 1928, and is in accord with the indicated specific synonomy.

Musca tessellata, Syst. Antl., 1805, p. 285.

Sex not mentioned, South America. Smidt and Lund collections.

In the Copenhagen Museum I found three females standing as types; as they showed no striking characters and I was not in a position to compare named material with them, I gave up elucidating the species. From Vienna, however, I have received a good series of both sexes, which are evidently what Wiedemann had when he wrote his description of the species.[7] There are 22 males and 12 females, seven of the latter on the same pin with a male, presumably taken in copulation. For a wonder it is a nearly homogeneous series, only three belonging to other species. While there is room to doubt the correctness of Wiedemann's identification, I have decided to accept it as authentic, since he saw the types. The specimens are all from the Winthem collection, and from Brazil, five collected by Natterer.

The species belongs to the *Oxysarcodexia* group of Townsend, and differs from *australis* Aldrich[8] so slightly that a figure of the genitalia (fig. 22) and a few comparative notes will make it recognizable. The forceps are distinctly narrower, as viewed from behind: the large lateral plates of the penis are rounded anteriorly, with serrations, not drawn out into a point as in *australis;* and the tips of the anterior claspers are not nearly so acute, being flattened dorso-ventrally and rounded in that view. *Aurifinis* Walker is a synonym.

SPECIES OF WIEDEMANN

IN AUSSEREUROPAISCHE ZWEIFLÜGELIGE INSEKTEN, VOL. 2, 1830

Sarcophaga praeceps, p. 355.

Male. Cuba. I received for study three males from the type lot; the species is the same as indicated by me in Sarcophaga and Allies (1916, p. 23, fig.), and is the type of Macquart's genus *Phrissopodia*.

Sarcophaga chrysostoma, p. 356.

I have reported on the types in Annals Entomological Society of America (vol. 17, 1924, p. 210).

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[5] Sarcophaga and Allies, 1916, p. 193, fig. 88.
[6] Ins. Ins. Menst., vol. 3, 1915, p. 118.
[7] *Sarcophaga,* in Auss. Zweif., vol. 2, 1830, p. 363.
[8] Sarcophaga and Allies, 1916, p. 282, fig. 135.

Sarcophaga georgina, p. 357.

I received from the Vienna Museum three supposed types, which had been previously seen and reported upon by Böttcher, in Deutsche Entomologische Zeitschrift (1913, page 369), where he asserts that *georgina* is the same as *haemorrhoidalis* Meigen. The specimens sent me were two males which Böttcher had labeled *haemorrhoidalis*, one being from Mexico and the other without locality; and one female from New York, which Böttcher had correctly labeled as *falculata* Pandelle. But Wiedemann's description is distinctly based on a female from Savannah, which apparently no one has seen since. I reported briefly on the specimens sent me, in Annals Entomological Society of America, (vol. 17, 1924, p. 210) but erroneously mentioned them as four in number. It is probably best to regard the species as a synonym of *haemorrhoidalis*, at least nothing else can be made of it.

Sarcophaga rubella, p. 357.

Male, Antigua. I saw the type in the Zoological Museum, Copenhagen. The red color seemed to me to be the result of long exposure to light. As I could not spread the genitalia, I made out little else.

Sarcophaga chlorogaster, p. 359.

Male and female, from Montevideo and La Plata. The types have apparently not been examined and may be lost; the species is, however, well known from the recognizable description, and is the type of the genus *Sarconesia* Bigot. See Shannon, Proceedings Entomological Society of Washington (vol. 28, 1926, p. 122), where it is placed in the Calliphoridae.

Sarcophaga plinthopyga, p. 360.

Male, St. Thomas, West Indies. I have discussed the type in Annals Entomological Society of America (vol. 17, 1924, p. 210); I had previously redescribed the species under the name *robusta* in Sarcophaga and Allies (1916, p. 207, fig.).

Sarcophaga dimidiata, p. 360.

Three males so labeled from the Vienna Museum, "Brasilien. Coll. Winthem." They represent three species, one being an undetermined *Sarcophaga*, one *Notochaeta cognata* Walker, and the other also a species of *Notochaeta*. This last is the only one of the three which has the dark spot between the antennae and orbit which is prominently mentioned by Wiedemann, hence I accept it as type. I refer it to *Notochaeta* largely on account of the genitalia and of the presence of hairs on the propleura—the last being a character I noted only in August, 1930, in the type species—too late, unfortunately, to apply it in examining most of the types.

Male.—Front at narrowest (above middle) 0.20 of head width, rather bulging in profile, the sides and parafacials with grayish pollen tinged with yellow. Vertical 1, ocellars normal, frontals 10 pairs, uppermost represented by scars, lowest at base of second antennal joint. The frontal rows diverge gradually from middle, but do not approach orbits. Parafacial bare, wider than third antennal joint; antennae black, third joint twice the second, arista long plumose nearly to tip; facial ridges with only a few hairs above vibrissae; cheek hardly one-third eye height; palpi black; back of head with black hair except just below neck, where the pale pile is somewhat conspicuous.

Thorax grayish pollinose with three black stripes and the usual short one above wing. Chaetotaxy: Dorsocentral 2, 3; acrostichal 0, 1 (prescutellar, small); humeral 3; posthumeral 1 (inner); presutural 1; notopleural 2; supraalar 3; intraalar 1; postalar 2; sternopleural 3; scutellum with 2 lateral, 1 subdiscal, no apical. Propleura with a few dark hairs; calypters and rims white.

Abdomen black with slight bluish tinge, pollen thin except on bases and sides of segments and on fourth; first and second segments without median marginals; third with a pair only slightly separated from 4 pairs of lateral marginals; fourth with marginal row of about 14. Genital segments small, black with gray pollen, the first with an interrupted row of about six marginals. Genitalia shown in Figure 25. Forceps brown, black apically, small, parallel, straight, with erect pile on back; accessory plates (outer forceps) dark reddish, shorter than forceps, tapering to a rather sharp black point; penis with large, globose head. First and second of the large abdominal sternites with soft hair and a single pair of long, erect hairlike bristles near apex.

Legs black, front and middle tibiae brown; middle tibia with one bristle on outer front side; tibiae without villosity.

Wings considerably infuscated; epaulet black, basicosta yellow, first vein bare, third setulose about two-thirds of the distance to small crossvein; fourth with rectangular bend and ending not very far before tip of wing; hind crossvein joining fourth vein at two-thirds the distance from small crossvein to bend.

Length 10.5 mm.

Sarcophaga rufiventris, p. 362.

I published a note on the Vienna material[9]; a portion of the material under the name was evidently of later origin than the publication of Wiedemann, and I disregarded the single old specimen because I believed it bore the wrong head, glued on. This specimen has come back to me again in the present shipment, from the Vienna

[9]Annals Ent. Soc. America, vol. 17, 1924, p. 211.

Museum, and I find that the head is authentic, although standing in a suspiciously crooked position with reference to the thorax; careful prying between the two reveals that the joint is normal. The specimen is labeled "Brasilien. Coll. Winthem," and agrees with the description, and I now accept it as the type.

It is entirely distinct from the species identified by me as *rufiventris* in Sarcophaga and Allies (1916, p. 150), although it runs in my keys directly to that species. It differs from my species in lacking the costal spine and apical scutellars; the front is wider, less bulging, and with fewer frontals; the back of the head has much longer and more abundant pale pile; and the third antennal joint is elongated, more than three times the second (hardly more than second in my species).

Townsend has renamed my species as *Rafaelia rufiventris* new genus and species, in the Proceedings of the Biological Society of Washington (vol. 30, 1917, p. 45).

The genitalia of the true *rufiventris* are quite different from those of the other species, but proved extremely difficult to extricate and the penis was lost in the operation. The specimen was in poor condition when received, but it is still possible to make a recognizable description. It must be a rare species, as I have not seen another specimen.

Male (Wiedemann's type).—Front at narrowest (middle) 0.29 of head width: in front view the head is decidedly wider than high. Parafrontals and parafacials rather wide, with pale yellow pollen, the parafacials with only a few small hairs near the orbit. Cheek about two-fifths of eye height, with yellow pollen; scars of five pairs of frontals besides the large upper one, which must have contrasted strongly in size with those next below it; lowest frontals above middle of second antennal joint, not located nearer the orbit than the others. Third antennal joint brownish yellow, long as stated; arista with usual plumosity. Palpi black.

Thorax black in ground color, with a conspicuous whitish stripe above the notopleural suture. Apparently 3 posterior dorsocentrals; sternopleural 3; scutellum with 2 lateral, no apical; propleura bare.

Abdomen rounded transversely (not flattened as in the misidentified species); basal segment blackish, remainder rather clear red and with some whitish pollen; second segment without median marginals; third and fourth each with one pair, well separated from lateral marginals. Genital segments red. Genitalia shown in Figure 27. Forceps red, slender, parallel and well separated, turned backward at base and slightly forward at tip; accessory plate very small; posterior clasper with a very long hair on front side; anterior clasper long, tapering, thin.

Wings hyaline, first vein setulose on basal half; third setulose nearly to cross vein; bend of fourth rectangular, hind crossvein joining fourth at two-thirds the distance from anterior crossvein to bend. First posterior cell rather widely open; epaulet red.

Legs black, femora stouter than usual; middle tibia with 2 bristles on outer front side; middle femur with small, slanting comb on lower hind side at tip; none of the tibiae with villosity.

Length about 9 mm.

Sarcophaga modesta, p. 363.

One female, from the Vienna Museum, "Brasilien. Coll. Winthem." Agrees with the description and appears to be the type. It agrees throughout with Townsend's *Sarcophaga argentea* in the Proceedings of the United States National Museum (vol. 43, 1912, p. 358); type of *Argoravinia*, new genus, in the Proceedings of the Biological Society of Washington, (vol. 30, 1917, p. 190), except that the pollen of the head is slightly yellowish in the Townsend type, a female from Piura, Peru. I believe, however, that the species is the same, as a slight fading in the old Wiedemann specimen would account for the difference. Townsend has correctly placed my *Sarcophaga fissa* as the male of *argentea*, in the Proceedings of the Entomological Society of Washington (vol. 20, 1918, p. 20); *fissa* was described in Sarcophaga and Allies (1916, p. 290, fig.). The wide parafrontals and parafacials, with the setulose first vein, seem to make this a good genus. No detailed description of the female having been published, I offer the following, taken from Wiedemann's type.

Female.—Front wide, at vertex 0.33 of head width, continuing of same width nearly to antennal level. Frontal stripe rather narrow, hardly wider than third antennal joint. Parafrontals and parafacials with smooth white pollen, barely tinged with yellow, the parafacials almost twice as wide as third antennal joint. Cheeks with less dense pale pollen, two-fifths of eye height. Antennae black, second joint reddish at tip, third over twice the second in length; arista normal. Palpi black. Back of head with two rows of black orbital setules above, changing to pale above the level of the lower curve of the eye; remainder of back of head with conspicuous pale hair. Verticals two; ocellars large, orbitals two; one upper frontal large, near eye (scar), the rest of the frontals in five pairs, the rows exactly parallel, lowest pair at base of second antennal joint.

Thorax gray, humerus and stripe above notopleural suture nearly white, other mesonotal stripes faint. Middle of scutellum and hind part of mesonotum with pollen changeable on middle line, light on one half and dark on the other according to the light. Chaetotaxy: Dorsocentral 2, 2 (the posterior are far back, some setules

between them and suture); acrostichal 0, 0; humeral 2 (or 3); posthumeral 2; notopleural 2; presutural 1; supraalar 3; intraalar 2; postalar 2; sternopleural 3; scutellum with 2 lateral, 1 small subdiscal, no apical. Propleura bare. Pleurae white pollinose on upper half and on sternopleura.

Abdomen with rather thin gray pollen, the dark ground showing through; an indistinct median dark stripe and on each side a dark spot on the anterior two-thirds of segments 2–4. No median marginals on segments 1 and 2, 3 with a pair, well separated from the lateral marginals; 4 with row of 8, large. Genital segments retracted, dark red.

Legs black; middle tibia with 3 bristles on outer front side, the uppermost small.

Wings subhyaline; first vein setulose from humeral halfway to its tip; third setulose about halfway to small crossvein; fourth with rectangular bend, thence straight to costa considerably before apex, the first posterior cell open. Hind crossvein joining fourth vein at last fourth of distance from anterior crossvein to bend. Epaulet and basicosta yellow.

Length 8.5 mm.

Sarcophaga albicans, p. 363.

Two males from the Vienna Museum. "Brasilien, Coll. Winthem." Undoubted types. Brauer and Bergenstamm included the species with two others in their new genus *Tripanurga* described in Zweiflügler des Kaiserlichen Museums zu Wien (pt. 5, 1891, p. 363), and placed it alone in the genus 2 years later (pt. 6, p. 165); Townsend designated *albicans* as type of *Tripanurga* in Insecutor Inscitiae Menstruus (vol. 4, 1916, p. 9).

Tripanurga appears to be a valid genus, the type species resembling *Sarcophaga pachyprocta* Parker (type of *Metoposarcophaga* Townsend) in the blunt abdomen with large genital segments, the hairy second vein, the presence of outer verticals in the male, the absence of apical scutellars in the male, and the absence of pale hair on the back of the head except a little below; it differs in the possession of a single pair of proclinate orbitals in the male, and in the absence of anterior acrostichals. It also resembles *Sarcophaga sulculata* Aldrich (*Zygastropyga* Townsend) in the shape of the abdomen and absence of acrostichals, but differs in lacking villosity on hind tibiae, the occurrence of orbitals in the male, etc.

Male.—Front at narrowest (below middle) 0.40 of head width; lower front prominent, forming an angle with face. Parafrontals, parafacials, cheeks, and posterior orbits with silvery pollen; the parafacials with only a few slender hairs; inner verticals large, outer two-thirds as long; ocellars normal, upper frontal reclinate

and strongly differentiated from remainder of frontals, which are in five pairs, the upper minute, the lowest at extreme base of antennae and not farther apart than the preceding pairs; facial ridges bare, converging somewhat at vibrissae, which are at oral margin; Palpi black, cheek two-fifths of eye-height. Antennae black, second joint fully half the third and a little reddish at tip. Frontal stripe mostly overlaid with the silvery pollen of the parafrontals.

Thorax gray, not strongly striped. Chaetotaxy: Dorsocentral 2, 3; acrostichal 2, 0; humeral 2; posthumeral 1; presutural 1; supraalar 3 (only the middle one large); intraalar 2 (far back); postalar 2; sternopleural 1, 1; scutellum with 2 lateral, 1 small subdiscal, no apical. Propleura bare.

Abdomen subsilvery, tessellated, with 3 irregular darker stripes. No median marginals on first and second segments; third with marginal row of 8 small; fourth with larger row of 8. Genital segments black, large, so that the depth of the abdomen increases from base to tip; the second segment is directly below the first, so that the suture is almost horizontal, and extends considerably forward under the abdomen, fitting closely into the main segments. Genitalia (fig. 24) small, red; forceps united into a small, slender beak; accessory lobes well developed, forming an outer pair of forceps as long as the inner, swollen at base and a little at tip, and fringed with a row of black bristles on the inner side; penis small, tip enlarged forward; posterior claspers slender, with a sharp tip curved forward; anterior claspers flat, narrowing to a sharp tip.

Wing tinged with brown, epaulet black, basicosta red; first vein setulose on basal half (in one specimen there is a strikingly large seta almost at the end of the row, in both wings); third vein setulose less than halfway to the crossvein; fourth vein with rectangular bend, the hind crossvein joining fourth closer to bend than usual, about at the last fifth from anterior crossvein. Costal segment between third and fourth equal to that between auxiliary and first.

Legs black; middle tibia with 2 bristles on outer front side; all tibiae without villosity; no comb on middle femur.

Length 9.5 mm.

Sarcophaga opima, p. 364.

One male from the Vienna Museum, "Brasilien. Coll. Winthem." Agrees with description and is undoubted type. It differs from the genus *Sarcophaga*, and I would place it provisionally in *Notochaeta*, although it lacks the hairs on the propleura which occur in the type species. The parafacials are bare, and the notopleura lacks the small bristles which alternate with the two large ones in *Sarcophaga*. The arista has very long plumosity nearly to the tip; the eye is large, so that the cheek is only one-fourth its height.

Front 0.25 of head width, the same for almost its whole length; parafrontals and parafacials with golden pollen, the former wider than middle stripe, latter as wide as the rather narrow third antennal joint; cheek and posterior orbit concolorous; back of head with black hair, the pale confined to a small area below neck. Verticals 2, outer half as long as inner; ocellars minute, proclinate; 7 distinct pairs of frontals, the uppermost one reclinate, not much differentiated from the rest, lowest at base of antennae; the frontal rows diverge slightly below, but do not approach orbits. Facial ridges bare except a few hairs next to vibrissae, which are at the oral margin; palpi black; proboscis small. Antennae black, third joint a little over twice the second, rather slender.

Thorax gray pollinose, tinged with yellow (which is less evident now than indicated by Wiedemann), with three distinct brown stripes and a brown spot on supraalars. Chaetotaxy: dorsocentral 2, 3; acrostichal 0, 0; humeral 2; posthumeral 1 (inner); presutural 1; notopleural 2; supraalar 3 (only the middle of any size); intraalar 1; postalar 2; sternopleural 2; scutellum with 3 lateral (middle weak), one small subdiscal, no apical. Calypters white, rim the same.

Abdomen blackish above, the gray pollen thin, on second and third segments confined to a narrow basal region, two submedian stripes not reaching the hind margins, and a lateral basal triangle continuing below; fourth segment gray except on apical half in middle region. First segment without median marginals, second with marginal appressed bristly hairs, third with marginal row of 8, fourth with row of 12, of which the outer are small. Genital segments small, first brown with yellow pollen and one pair of bristles, second reddish. Genitalia as in Figure 21. Forceps small, reddish, quite flat, straight, uniformly tapering, the tips black, sharp. Accessory plates (outer forceps) small, narrow, reddish yellow, with sharp tips. Penis in the single specimen strongly bent forward at middle, the stalk yellow, head black, shining. Fifth sternite almost invisible, the three intermediate ones large, with soft hair.

Legs black, tibiae brownish; pulvilli but little enlarged; no villosity on tibiae; middle femur at tip below on hind side with a few short bristles, not however forming a comb; middle tibia with one bristle on outer front side, lower down than usual (at second third).

Wings brown, the color uniform as Wiedemann says. Bend of fourth vein rectangular, with small appendage; first vein bare, third setulose halfway to crossvein. Hind crossvein joining fourth vein at second third of distance between anterior crossvein and bend.

Length 8 mm.

Sarcophaga comta, p. 365.

Male.—Brazil. Not seen, perhaps not now in Vienna Museum. The description contains several good points—the pollen of the head is white or silvery, except that of cheek, which is almost golden; abdomen reddish, venter yellowish-red, with yellowish hairs. Length 7 mm. A specimen from Vienna labeled "comtae vicina" is *Paratheresia claripalpis*, but this can hardly be correct, as *comta* has black palpi.

Sarcophaga phoenicurus, p. 365.

Female.—Brazil, in Frankfort Museum. The single type is still preserved, as I am informed by Dr. Elle Franz, in the Senckenberg Museum. It has not been seen.

Sarcophaga lambens, p. 365.

Two males and six females received from the Vienna Museum, "Brasilien. Coll. Winthem." All are the same species and apparently of the type series. Some of the types were said to be in the Copenhagen Museum, where I did not see them, as I examined only the Fabrician types there. The series belongs to the very common tropical species described by Townsend as *Sarcodexia sternodontis* in the Journal of the Institute of Jamaica (vol. 1, 1892, p. 106). According to a manuscript note from Doctor Townsend, the species was also described as *Cricobrachia anisitsiana* by Enderlein, in the Archiv für Klassifikatorische und Phylogenetische Entomologie (vol. 1, 1928, p. 19), from Paraguay. Townsend saw the Enderlein type. I have discussed the species in Sarcophaga and Allies (1916, p. 265), with a figure of the genitalia; and more recently have analyzed the numerous rearing records in the Journal of Economic Entomology (vol. 20, 1927, p. 590). I referred the species to *Sarcophaga* in the articles.

Three additional specimens, "Brasilien. Coll. Wiedem.," include one of each sex of the species just mentioned, and one female of *varia* Walker.

Sarcophaga calida, p. 366.

Female.—Brazil. Not seen. One type is in the Senckenberg Museum, Frankfort. Van der Wulp, in establishing the genus *Sarcophagula* (Tijdsch. v. Ent., vol. 30, 1887, p. 173), said that the following Sarcophagas of Wiedemann apparently belong in it: *calida*, *surinamensis*, *terminalis*, *amata*, *sugens*, *obsoleta*, and *parvula*. Brauer and Bergenstamm referred all these species to *Sarcophagula* without question in their Zweiflügler des Kaiserlichen Museums zu Wien (pt. 5, 1891, p. 414). As I have never made out more than the one species *occidua* Fabricius as belonging to the genus, the

species listed are quite likely all synonyms; this is true of *parvula* and *sugens*, the only ones I have seen.

Sarcophaga surinamensis, p. 366.

Female and male.—Surinam, in the Senckenberg Museum, Frankfort; one type reported to be still preserved there. Not seen; see note under *calida*.

Sarcophaga terminalis, p. 366.

Male.—Brazil. Not seen, and apparently no longer preserved in the Vienna Museum. See note under *calida*.

Sarcophaga amata, p. 367.

Male.—Brazil. Not seen, and presumably not now in the Vienna Museum. See note under *calida*.

Sarcophaga sugens, p. 367.

Female.—Brazil. Eleven specimens so named were received from the Vienna Museum as types. They are labeled "Brasilien. Coll. Winthem." Of these one male and five females, to which I restrict the species, are *Sarcophagula occidua* Fabricius, a common tropical American species. Of the others, four are *Johnsonia setosa* Aldrich. They can hardly have been a part of the original series, which was said to be females, while these are easily recognized as males. The other specimen, a female, is *Sarcophaga rapax* Walker, or a closely related species. See note under *calida*.

Sarcophaga obsoleta, p. 367.

Described from one female, West Indies. Not seen, apparently not now in Vienna Museum. See note to *calida*.

Sarcophaga parvula, p. 368.

One male from the Vienna Museum, "Brasilien," agreeing with the description, in which the sex was not stated. Equals *Sarcophagula occidua* Fabricius, as expected. See note under *calida*.

SPECIES OF ROBINEAU-DESVOIDY

All described in Essai sur les Myodaires, 1830. A few of the descriptions say that the specimen is in the Museum, meaning the Musée National d'Histoire Naturelle in Paris. These types are mostly still in existence. Bigot obtained a few named specimens from Robineau, perhaps types, and several with labels in the handwriting of the latter are now in the collection of Mr. Collin, which includes that of Bigot. I do not know of any other Robineau material now in existence.

Peckia imperialis, p. 335.

Male and female, Cuba. Type lost, but it is a very recognizable species; see Aldrich, Sarcophaga and Allies (1916, p. 22), where it is made a synonym of *Sarcophaga praeceps* Wiedemann, in the genus *Phrissopodia* Macquart.

Peckia lamanensis, p. 335.

From Lamana, sex not stated. See note under *Musca gulo* Fabricius.

Peckia aterrima, p. 336.

Male, Carolina.

Peckia plumipes, p. 336.

Male, Haiti.

Peckia lanipes, p. 336.

Male, Carolina.

Myophora brasiliensis, p. 338.

Female, Brazil. Type said to be in the Museum, but I did not find it there.

Myophora humboldti, p. 338.

Sex not stated, Peru.

Myophora chrysella, p. 339.

Male and female, Brazil.

Myophora flaveola, p. 339.

Female, Brazil. Said to be in the Museum, but I did not find it there.

Myophora lherminieri, p. 339.

One female, Carolina, in the Museum. Readily recognizable as the species described by Parker as *Ravinia communis*.[10] Walker described it as *Sarcophaga anxia*, *querula*, *avida*, *rediviva*, *aspera*, *rabida*, *acerba*, and *comes;* while Thompson described it as *pallinervis*. These specific names are noted farther on.

Myophora fervida, p. 341.

Female, Haiti.

Myophora viridescens, p. 342.

Female, Nova Scotia.

Myophora cubensis, p. 342.

Sex not mentioned, Cuba.

[10] Proc. Boston Soc. Nat. Hist., vol. 35, 1914, p. 55.

Myophora consobrina, p. 344.

Male, Philadelphia.

WALKER'S SPECIES

IN TRANSACTIONS OF THE LINNAEAN SOCIETY, VOL. 17, 1837

Sarcophaga lateralis, p. 352.

One male, St. Paul's in Brazil. Is a *Ptilodexia.*

Sarcophaga vittata, p. 353.

Not found in British Museum.

Sarcophaga varia, p. 353.

One male, Gorrite Island, off Maldonado, Uruguay. The specimen mentioned as being from Port Famine is not now in the British Museum, the only one found being from Gorrite Island. It is a male, a striking form and easily recognized. Head with golden pile; notopleural stripe golden and a spot on mesopleura and one on pteropleura as well as three almost confluent on sides of abdominal segments two, three, and four, all golden. Mesonotum with three broad black stripes, leaving two narrow yellow stripes besides the notopleural; the yellow stripes continued on scutellum. One vertical; ocellars proclinate; one reclinate frontal, six others to base of second antennal joint. Parafacials with several long hairs irregularly arranged. Cheek almost one-half the eye height. Acrostichal 0, 1; dorsocentral 3, 3 (the first postsutural pair some distance back of suture); presutural one; sternopleural 3; scutellum with 2 lateral, no apical. Abdomen rather broad and flat, genital segments large, giving a truncate effect to abdomen; both genital segments black, the first in part golden pollinose and with row of bristles. Genitalia as in Figure 1. Forceps black, flat, the tips blunted and turned a little back. Accessory plate not readily distinguished. Posterior clasper long, curved, sharp; anterior clasper twisted and turned to the side apically in a remarkable way. The penis is thick and bulky and has a wing extending on each side, the right one conspicuously larger than the left and with several claws. Fifth sternite with wide curved opening, a slight lobe at each end projecting noticeably. Hind tibia not villous but with dense depressed hair. Mid tibia almost villous on apical half of flexor side, and with two bristles on outer front side. First vein bare, third with eight to ten hairs. Synonyms are *flavicosta* Macquart, *chilensis* Macquart, and *nobilis* Thomson.

IN LIST OF DIPTERA IN THE BRITISH MUSEUM, VOL. 4, 1849

Sarcophaga jejuna, p. 811.

Female, Venezuela. Not found in British Museum.

Sarcophaga immanis, p. 815.

Female from Honduras. Not found in British Museum.

Sarcophaga stimulans, p. 817.

One female "North America?" *Quadrisetosa* Coquillett 1901, is a synonym. Redescribed by Hall.[11]

Sarcophaga rapax, p. 818.

One female, "North America?" *Helicis* Townsend is undoubtedly a synonym of this.

Sarcophaga anxia, p. 818.

One female, North America. A synonym of *lherminieri* Robineau-Desvoidy (*communis* Parker).

Sarcophaga importuna, p. 819.

One female, "North America?" *Pachyprocta* Parker is a synonym.

Sarcophaga aegra, p. 821.

One female, Massachusetts. It is the same as *haemorrhoidalis* Fallen, 1816, a very widespread species.

Sarcophaga querula, p. 821.

One male, "North America?" A synonym of *lherminieri* Robineau-Desvoidy (*communis* Parker).

Sarcophaga avida, p. 822.

One female, Nova Scotia. A synonym of *lherminieri* Robineau-Desvoidy (*communis* Parker).

Sarcophaga rediviva, p. 823.

One female, St. Martin's Falls, Canada. A synonym of *lherminieri* Robineau-Desvoidy (*communis* Parker).

Sarcophaga rabida, p. 823.

One female, Nova Scotia. A synonym of *lherminieri* Robineau-Desvoidy (*communis* Parker).

Sarcophaga acerba, p. 824.

One female, Nova Scotia. A synonym of *lherminieri* Robineau-Desvoidy (*communis* Parker).

Sarcophaga aspera, p. 825.

Two females, "North America?" Both are identical with *lherminieri* Robineau-Desvoidy, although Walker refers to one as a variety.

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[11] Annals Ent. Soc. Amer., vol. 21, 1928, p. 346, with figs.

Sarcophaga violenta, p. 826.

One male, Galapagos Islands. Townsend described this species as *Gigantotheca galapagensis*, new genus and species.[12] I compared the spread genitalia with those of a Townsend paratype. The accompanying sketches (fig. 2) were made from the Walker type. Head of common *Sarcophaga* type, the frontal rows diverging below; acrostichals represented by only a small prescutellar pair; posterior dorsocentrals only two far back, the hindmost largest; no marginals on first and second abdominal segments, a row on third. Second genital segment red, the first blackish and bearing a row of six stout bristles on hind margin. Fifth sternite deeply excised as usual, at the bottom of the excision a pair of small protuberances, each with a dense brush of very short, stubby black spines. Genitalia as figured. The forceps are very wide at base, red in color, becoming black about the middle. Viewed from behind they are almost contiguous for some distance, then suddenly spread apart and are parallel to the tips; the contiguous portion is covered behind with fine yellow hair, beyond which are the black bristles shown in the figure. The penis has two median processes on the anterior side, the first black, the second yellow; its tip spreads out in a thin membrane, not well shown in the figure, or better spread out in the Townsend type. The restricted occurrence and the additional characters given by Walker and Townsend should make this easily recognizable.

Sarcophaga vigil, p. 831.

One male, Nova Scotia. Type not found in the British Museum, but the color pattern is so striking that it could hardly be any other species than the one indicated by me in Sarcophaga and Allies (1916, p. 29), in the genus *Wohlfahrtia*.

Sarcophaga inoa, p. 832.

One female, Galapagos Islands. I did not see the type, but Austen has published notes on it.[13] He refers it to Brauer and Bergenstamm's "Section Paramacronychia," quite distinct from *Sarcophaga*.

Sarcophaga anaces, p. 833.

One male, "North America?" Runs to *melampyga* in Sarcophaga and Allies (1916, p. 107), and agrees in most details, including the erect bristles of the second genital segment, absence of comb on middle femur, etc.; it differs, however, in not having the striking patches of whitish hair on the sides of the scutellum, in having a complete row of marginals on the third abdominal segment, a large

[12] Proc. Biol. Soc. Wash., vol. 30, 1917, p. 195.
[13] Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 342.

upright pair of apicals on the scutellum, and in having the middle pair of marginals of the fourth segment situated at the margin. The genitalia are small and I could not make a satisfactory sketch of them, but the penis has a slender basal segment, the apical part rather globose. As I could not match the species, it remains uncertain whether it is North American.

Sarcophaga ortogesa, p. 834.

One male, Chile. This is the same as *Musca chilensis* Walker,[14] of which *Phrissopodia splendens* Macquart,[15] is also a synonym. Shannon has made this species the type of the genus *Neta*.[16] There are several other synonyms, to be discussed elsewhere. Walker indicated the genus *Cynomyia* for this species, but seemed to regard it as a subgenus of *Sarcophaga*.

Sarcophaga proerna, p. 835.

Female.—Montevideo. I did not find the type in the British Museum. The description indicates that it is not a *Sarcophaga*, but probably something similar to *ortogesa*.

IN INSECTA SAUNDERSIANA, 1852

Sarcophaga hirtipes, p. 321.

Colombia. Type not seen in the British Museum. The description indicates a male, but the sex is not stated. The length, 17 mm., with the golden pollen, red genital segments and strikingly villous tibiae, seem to limit the species to *Musca gulo* Fabricus,[17] of which I saw the type in Copenhagen.

Sarcophaga parva, p. 321.

One male, Para. A synonym of *Musca occidua* Fabricius, which belongs to *Sarcophagula*.[18]

Sarcophaga derelicta, p. 322.

One male, now headless, United States. The same as *quadrisetosa* Coquillett, 1901.

Sarcophaga comes, p. 323.

One male, United States. A synonym of *lherminieri* Robineau-Desvoidy.

Sarcophaga advena, p. 324.

Male and female, Brazil. Not found in British Museum.

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[14] Trans. Linn. Soc., vol. 17, 1837, p. 354.
[15] Dipt. Exot., vol. 2, pt. 3, 1843, p. 288.
[16] Proc. Ent. Soc. Washington, vol. 28, 1926, p. 123.
[17] *Sarcophaga wiedemanni* Aldrich, Sarcophaga and Allies, 1916, p. 193.
[18] Aldrich, Sarcophaga and Allies, 1916, p. 40.

Sarcophaga incerta, p. 324.

One female, Jamaica. Runs to the vicinity of *hillifera* Aldrich, but I am unable to distinguish several species in the female sex, so can not identify farther.

Sarcophaga aurifinis, p. 325.

One male, Brazil. A synonym of *tessellata* Fabricius, but the Wiedemann material from Vienna on which I base this conclusion was not received until after the preparation of the plate containing Mr. Hall's reproduction of my figure of *aurifinis* made at the British Museum (fig. 3).

Sarcophaga cognata, p. 325.

One male, South America. Belongs in *Notochaeta*, which will be discussed elsewhere.

Sarcophaga fulvivitta, p. 326.

South America, sex not indicated. Not seen in British Museum.

Sarcophaga contermina, p. 326.

Brazil, sex not indicated. Not seen in British Museum.

Sarcophaga bifrons, p. 327.

One male, South America. Four dorsocentrals, but anterior one very small. First vein bare, third setulose to crossvein; hind tibiae villous; acrostichals only coarse hairs, one pair bristly just before suture. Head ordinary; cheek two-fifths eye height, with pale hairs on lower two-thirds, some black above. Middle femur not with distinct comb. Genitalia (fig. 4) wholly black, the hook at end of penis double and the two long filaments passing between; accessory plate rather long.

Sarcophaga assidua, p. 328.

One male, one female, United States. I greatly misidentified the species in Sarcophaga and Allies (1916, p. 285); my species is *ventricosa* Van der Wulp, 1896. The Walker types belong to the *Chaetoravinia* group, but different from all of Mr. Hall's species in his treatise.[19] Coxae, femora, and tibiae entirely red, tarsi black. First vein setulose only to the little knot next to the bend of the auxiliary (eight setules on each wing). No outer verticals; three pairs anterior acrostichals; four posterior dorsocentrals. Cheek two-fifths the eye height, with black hair; palpi almost black. No orbitals in male. A distinct comb present on middle femur; middle tibia with one bristle on outer front side (but there is a smaller above it on one leg). Genitalia as in Figure 5; genital segments yellow, first with a row of bristles. Penis in profile with circular

[19] Annals Ent. Soc. Amer., vol. 21, 1918, p. 331.

notch in tip, differing from all of Hall's figures. The forceps are reddish-yellow, with distinctly black tip, and the slender prongs of the fifth sternite also have a black tip with a tuft of hairs. I have not seen the species before. The female agrees with the male.

Sarcophaga fulvipes, p. 328.

United States, sex not stated. Not found in the British Museum. There is an earlier *Sarcophaga fulvipes* of Macquart,[20] hence a new name will be necessary for this species if the types should be found, unless it proves identical with Macquart's species, which is not very unlikely.

Sarcophaga basalis, p. 328.

One male, United States. Described by me as *Sarcophaga deceptiva* in Sarcophaga and Allies (1916, p. 186).

Sarcophaga pallipes, p. 329.

One female, United States. Legs yellow, four dorsocentrals, first vein bare, mid tibia with two bristles. I can not separate from females of *singularis* and several others.

Sarcophaga chrysotelus, p. 329.

One male, South America. Has postscutellum well developed and does not belong to the family Sarcophagidae; will be discussed elsewhere.

IN TRANSACTIONS OF THE ENTOMOLOGICAL SOCIETY OF LONDON, NEW SER., VOL. 4, 1857

Sarcophaga decedens, p. 207.

Male, Colombia. Not found in British Museum.

Sarcophaga subsericans, p. 207.

Male, South America. Not found in British Museum.

Sarcophaga? punctipennis, p. 208.

One male, Colombia. It is a Tachinid with retracted hind crossvein; postscutellum prominently developed; a dark spot on anterior crossvein, one at each end of hind crossvein, and a fourth at bend of fourth vein. Does not run to any genus in my key to forms with retracted hind crossvein.[21] To be discussed elsewhere.

Sarcophaga injuncta, p. 208.

Female, Brazil. Not found in British Museum.

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[20] Dipt. Exot., vol. 2, pt. 3, 1843, p. 105.
[21] Trans. Amer. Ent. Soc., vol. 52, 1926, p. 9.

IN TRANSACTIONS OF THE ENTOMOLOGICAL SOCIETY OF LONDON, NEW SER., VOL. 5, 1860

Sarcophaga intermutans, p. 308.

One female, Mexico, showing no striking characters.

Sarcophaga perneta, p. 308.

One male, Mexico. Belongs to the *Oxysarcodexia* group, and seems unlike any which have been described in recent years. Head with golden pollen; one vertical; ocellars hairlike, small, divergent; two reclinate frontal pairs, seven others to middle of second antennal joint. Antennae and palpi black; cheek over one-fourth the eye height; parafacial with minute hairs. Mesonotum with three heavy black stripes, pollen at sides and on mesopleura yellow; abdomen with distinct, upturned, slender apicals; acrostichals slightly developed before suture, behind damaged; dorsocentral 3, 4; presutural 2; sternopleural 3. Abdomen strongly tessellated, golden on third and fourth segments, the latter mostly red in ground color; fifth sternite imperceptible. Genital segments yellow with golden pollen, first with row of bristles apically. Genitalia as in Figure 6. Forceps slender, yellow to hump, remainder black, narrow in rear view; the globose terminal part of the penis is black. First vein bare, third with about eight setules, no costal spine. Legs black, middle tibia with one bristle on outer front side.

The nearest species known to me is *culminata* Aldrich, which has a tuft on the back of the penis, etc.

Sarcophaga innota, p. 308.

One female, Mexico, which shows no striking characters.

Sarcophaga conclausa, p. 309.

One female, Mexico, which shows no striking characters.

Sarcophaga despensa, p. 309.

One female, Mexico, not in good condition and showing no striking characters.

Sarcophaga effrenata, p. 309.

One male, Mexico, agreeing exactly with the description and figures of *Sarcophaga adamsi* Hall,[22] which I think without doubt a synonym.

Sarcophaga fortipes, p. 310.

Male, Haiti. Not found in British Museum. The description indicates something in the vicinity of *chrysostoma* Wiedemann.

SPECIES OF MACQUART

The collection of Macquart was destroyed, and the only types still existing, as far as I am aware, are those which he stated to be

[22] Annals Ent. Soc. Amer., vol. 21, 1928, p. 345.

in the collection of Bigot (now the property of Mr. J. E. Collin) and in the Museum, meaning the Musée National d'Histoire Naturelle in Paris. Not all of these can now be found, as both collections have suffered somewhat in the lapse of years.

IN HISTOIRE NATURELLE DE DIPTÈRES, VOL. 2, 1835

Phrissopodia brullei, p. 223.

Male and female, South America.

IN DIPTÈRES EXOTIQUES, VOL. 2, PART 3, 1843

I give the original pagination, followed by that of the separate edition, more frequently quoted, in parenthesis.

Phrissopodia splendens Macquart.

Macquart described two species of South American Calliphoridae under this name. The first was in Diptères Exotiques (vol. 2, pt. 3, 1843, p. 253 (sep., p. 96), pl. 11, fig. 3). It was said to be from Africa, but one specimen was from Chile. The type was in the Paris Museum, but seems to be lost now, as it was not found there by Shannon nor by me. The description and figure leave little doubt that the species is the same one which he described as *Calliphora chilensis* in the same work (p. 288 (sep., p. 131), pl. 16, fig. 1.) The types were said to be in the Museum and in his own collection. No specimens of *chilensis* are to be found in the Paris Museum, but in the Bigot collection, now owned by Mr. Collin, I found a series with a Macquart label, presumably the types of this species, as Bigot had many of Macquart's types. It is the same species which Townsend described as *Sarconesiopsis caerulea* in Insecutor Inscitiae Menstruus (vol. 6, 1918, p. 156) from Peru. Shannon had made out this synonymy from Macquart's description and Townsend's type, and published it (Proceedings of the Entomological Society of Washington, vol. 28, 1926, p. 123).

The second *Phrissopodia splendens* Macquart was published in Diptères Exotiques, Supplement 4, pt. 2, 1851, p. 204 (sep., p. 231), from Cobija, Bolivia. The type is still in the Paris Museum, and has been seen by Shannon and by me. Shannon erected the genus *Neta* for this species, on the page of his work above cited. The specific name is antedated by *Musca chilensis* Walker in the Transactions Linnean Society (vol. 17, 1837, p. 354). I saw the type of this species in the British Museum. It is very striking species, and there are other synonyms.

Enderlein has proposed the new genus *Callyntropus* in Deutsche Entomologische Zeitschrift (1930, p. 70), designating the first *splendida* Macquart as type. He gives only a few words of description, but enough to show conclusively that he had before him the

second species, not the first. He mentions the thickened femora and the strong bushy pilosity of all the legs—characters entirely lacking in the first species. I therefore regard his genus as a synonym of *Neta* Shannon. If his citation is taken as decisive as against the characters given, it makes Enderlein's genus a synonym of *Sarconesiopsis*, of which *caerulea* Townsend (=*splendens* 1843) is type.

The reported occurrence of the 1843 species in Africa can not now be explained, except as an error of labeling, Enderlein cites the species only from Chile.

Phrissopodia maculata, p. 254 (97) pl. 11, fig. 4.

Male, Cayenne.

Sarcophaga rufipalpis, p. 259 (102).

Male and female, Brazil. Said to be in the Museum, but I did not find it.

Sarcophaga quadrivittata, p. 259, (102), pl. 12, fig. 4.

One male, Para. In *Ravinia* group, almost the same as my *ochracea*,[23] which is a southern species and turns out to be distinct from *lherminieri* in the puparium. Head light golden, thorax with only gray pollen. Abdomen with smooth golden pollen on sides and two rows of oblong gray pollinose spots; extreme tip of fourth and the genital segments red; fifth sternite apparently without brush. Mesonotum with notopleural yellowish stripes and a pair intermediate gray; dorsocentrals apparently three. Sternopleural 1, 1. Legs black, hind tibiae not villous. First vein bare, third with three or four setules.

Sarcophaga flaviceps, p. 260 (103), pl. 13, fig. 3.

Female, near Para, Brazil. Two females, in Museum, each bearing a label by Macquart. One is near *sternodontis* Townsend, the other similar to *ochracea* Aldrich.

Sarcophaga rufipes, p. 260 (103).

Male, Chile. Said to be in the Museum, but I did not find it.

Sarcophaga chilensis, p. 261 (104), pl. 11, fig. 6.

One male, one female, former with Macquart label, in Museum as stated. A synonym of *varia* Walker.

Sarcophaga flavicostata, p. 261 (104), pl. 13, fig. 4.

One female, Concepcion, Chile. In Museum as mentioned, and is a synonym of *varia* Walker, like the preceding.

Sarcophaga cayennensis, p. 262 (105).

Female, Cayenne.

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[23] Sarcophaga and Allies, 1916, p. 255.

Sarcophaga trivittata, p. 262 (105), pl. 13, fig. 3.

Female, Cuba and Mexico. Although he mentions a specimen in the Museum, it is not now to be found there.

Sarcophaga fulvipes, p. 262 (105), pl. 12, fig. 5.

Male, Cuba. Said to be in the Museum, but not now to be found there. The unusual color of the legs apparently restricts to a very small number of species, and it is probably identified correctly by me in Sarcophaga and Allies, (1916, p. 182).

Sarcophaga cubensis, p. 263 (106), pl. 12, fig. 6.

Female, Cuba. There is in the Museum a female without abdomen from the Guerin-Meneville collection, labeled as *cubensis*. It does not have Macquart's label, and is evidently not the type.

Sarcophaga trigonomaculata, p. 263 (106), pl. 13, fig. 2.

Female, Mexico. Macquart attributes the species to Guerin, who did not publish a description.

IN DIPTÈRES EXOTIQUES, SUPPLEMENT 1, 1846

Sarcophaga flavifrons, p. 319 (191).

One female, Brazil. In Collin collection; undoubted type, which was said to be in Bigot's collection. The specimen probably belongs to the *Oxysarcodexia* group, but shows few distinctive characters. Head golden; clypeus cinereous; facial ridges black; dorsocentrals four, the anterior small; first vein bare.

Sarcophaga argyrocephala, p. 320 (192).

Male, Texas. The description gives little indication of the characters.

IN DIPTÈRES EXOTIQUES, SUPPLEMENT 3, 1848

Sarcophaga diversimaculata, p. 214 (54), pl. 6, fig. 4.

Female, Brazil. In Bigot collection. I found the type in Mr. Collin's collection as expected. Cheeks golden, parafacials only yellow, front golden; frontal rows divergent; one large dorsocentral far back, several small; a heavy pollinose yellowish stripe from humerus toward base of wing; a yellowish pollinose spot on mesopleura; pteropleura rather strikingly bare and whitish pollinose on anterior part.

IN DIPTÈRES EXOTIQUES, SUPPLEMENT 4, CONTINUATION, 1851

Sarcophaga rubriventris, p. 208 (235).

One male, Corrientes, Brazil. Type in Museum. Hind tibiae and third antennal joint missing. Dorsocentrals three. Abdomen on disk covered with a reddish substance, probably not natural, not

reaching sides but reaching front and on third segment almost the hind edge; on fourth segment not extending so near to hind edge. Genital segments wholly black, small, retracted. Hind tibiae not villous; one bristle on outer front side of middle tibia. Costal spine present. First vein bare; third with three or four setules, and beyond cross vein somewhat curved forward so that the first posterior cell is wide in middle.

Sarcophaga rubrianalis, p. 208 (235).

One male, Chile. In Museum, with Macquart label. Hind calypters brown. Pollen not in yellow spots. Dorsocentrals four, only two hindmost large. Genital segments and posterior third of fourth abdominal red; abdomen black with little pale pollen, fifth sternite margined with red. Tibiae not villous.

IN DIPTÈRES EXOTIQUES, SUPPLEMENT 5, 1854

Sarcophaga notata, p. 128 (108).

Female, South America.

Sarcophaga aureiceps, p. 128 (108).

Female, South America. In Bigot collection. I found the type in Mr. Collin's collection, but it is in very bad condition, and I could make out only that it belongs to the *Oxysarcodexia* group.

SPECIES OF RONDANI

IN STUDI ENTOMOLOGICI, TRUQUI, VOL. 1, 1848

Sarcophaga circumcisa, p. 76.

Male, Brazil.

IN NUOVI ANNALI SCIENZA NATURALI BOLOGNA, SER. 3, VOL. 2, 1850

Sarcophaga pudica, p. 174.

Female, St. Sebastian Island, Brazil.

Sarcophaga varipes, p. 364.

Female, Rio Napo, Brazil.

Sarcophaga pigmea, p. 365.

Female, Rio Napo, Brazil.

IN ANNUARIO DELLA SOCIETA NATURALISTI IN MODENA, VOL. 3, 1868

Sarcophaga oralis, p. 26.

Sex not stated, Bahia. Two-line description.

Sarcophaga nurus, p. 26.

"Haemorrhoidalis Mg. non Fall." Occurs in Buenos Aires. Probably the South American specimens so determined were *barbata* Thomson; see note under that species.

SPECIES OF SCHINER

ALL IN NOVARA REISE, 1868

Sarcophaga dichroa, p. 313.

The material sent me in May, 1930, from the Vienna Museum contained but one specimen bearing this label, but it was evidently not the type, as it did not agree with the description and was dated 1870 (Philippi, Chile, 1870), after the publication of Schiner's work. It appears likely that the single type specimen indicated by Schiner, a female, has been lost. The only reference to the species that I can find is in Brauer and Bergenstamm, in their Zweiflügler des Kaiserlichen Museums zu Wien (pt. 5, 1891, p. 414), where it is listed in *Sarcophaga* as one of the species seen.

The description states that the species has a black mesonotum with four white stripes; scutellum red at tip; abdomen steel-blue with some pale pruinosity; all femora greatly thickened, the middle ones below with short, regularly arranged bristles, which are absent from the other femora; fourth vein with acute angle at bend, and somewhat bent backward at this angle; all veins bare.

These characters indicate that the species goes in Calliphoridae, probably close to *Sarconesia;* the femoral characters are peculiar. It should be recognizable from the description, but I have not seen it.

Sarcophaga xanthophora, p. 313.

Described from one male and four females, from "South America." The series sent from the Vienna Museum now includes two males and three females labeled "Lindig. 1864. Venezuela"; one female of a different species from Brazil; and a male of a different genus from Venezuela, the place being illegible. The Lindig lot is evidently the type series, from which I make the following description:

Male.—Posterior dorsocentrals four, hind tibiae not villous, genital segments red. Front at narrowest (above middle) .22 of head width; pollen of front, face, cheek and posterior orbit deep golden, frontal stripe dark brown; antennae and palpi black; hairs of back of head all black except a few below the neck. One pair verticals; ocellars rather small; upper frontal not differentiated from the following, the frontal rows consisting of about 15 pairs of rather strong and erect bristles, the lowest not diverging to any extent and reaching the middle of second antennal joint. Third antennal joint over twice the second, arista with the usual plumosity on the basal three-fifths.

Mesonotum golden pollinose, with three uniform and distinct black stripes, the middle one extending upon the scutellum, and the usual small, short stripe above root of wing. Chaetotaxy: Dorso-

central 3, 4; acrostichal 3, 2; humeral 3; posthumeral 2; presutural 2; supraalar 3; intraalar 2; postalar 2; sternopleural 3; scutellum with 3 lateral, 1 subdiscal, 1 small erect decussate apical; propleura bare, yellow pollinose, as is also the mesopleura.

Abdomen black, with light golden pollen, a broad median black stripe and an irregular changeable one each side. First and second segments without median marginals; third with a depressed marginal row, the middle pair larger; fourth with well-developed marginal row. Genital segments red, the first somewhat dark at base and with marginal row. Genitalia as in Figure 23. Forceps short, flat, distinctly separated, the tips black and prolonged laterally in a slender tooth; accessory plate red, rather broad; claspers black, brown at base, strongly curved; penis blackish, with a large hood, opening anteriorly. Fifth sternite inconspicuous.

Wings subhyaline; first vein bare, third setulose about halfway to crossvein; fourth with rectangular bend, the hind crossvein joining at three-fourths of the distance from small to bend; epaulet black, basicosta yellow.

Legs black; middle tibia with one bristle on outer front side, middle femur with strong comb on lower hind side beginning only a little beyond the middle. All tibiae destitute of villosity.

Female.—Front on upper half .26 of head width, the usual orbitals and outer vertical present. No apical scutellars. Abdomen short, shriveled in types, genital segments golden pollinose on yellow ground. No comb on middle femur.

Length, male, 9.5 mm.; female, 8.8 mm.

Sarcophaga truncata, p. 314.

One male, two females, from the Vienna Museum, agreeing with data and description of Schiner; labeled "Novara Reise, Chili." The species is a synonym of *Sarcophaga varia* Walker.

Sarcophaga amorosa, p. 314.

One male, received from the Vienna Museum, Brazil, undoubted type, as the penis is strikingly bent back out of its usual position, as mentioned by Schiner. The "Borstenbüschel" of the genitalia is, however, only a small group of hairs on the second genital segment.

Belongs to the *Oxysarcodexia* group, and runs to *bakeri* Aldrich in my Sarcophaga and Allies, having a pair of apical scutellars and gray pollen on the head. Genitalia as in Figure 26. The penis is so bent back that it appears abnormally long, and spreads the tips of the forceps apart; these tips are narrow and obliquely truncate, the inner side longer. The claspers are longer than in *bakeri*, as well as the penis. The most obvious difference is in the long, diverging lobes on the front of the penis, which in *amorosa*

are completely united above, while in *bakeri* they are deeply divided on the middle line; this of course does not show in side view, but is striking in the longitudinal. I have seen no other specimens.

Length 6.6 mm.

SPECIES OF THOMSON

IN EUGENIES RESA, 1869

Sarcophaga occipitalis, p. 532.

One female, Callao, Peru. The species was described as *Sarcophaga auribarbata* by Townsend,[24] and later more fully by me as *Sarcophaga cotyledonea* in Sarcophaga and Allies (1916, p. 187, fig.) It is known to occur in Peru, Brazil, British Guiana, and Guatemala. Townsend has asserted [25] that only the female of my *cotyledonea* belongs here, the true male of the species being my *capitata* (1916, p. 209). I do not agree with his opinion.

Sarcophaga barbata, p. 533.

One female, Honolulu. This is the same species which was described as *Sarcophaga falculata* by Pandelle,[26] and which occurs not only in Europe, but in Northern India and widely throughout North America. In 1917 I received Hawaiian material in both sexes from Doctor Illingworth which convinced me of this synonymy, but have withheld publication until Thompson's type could be seen. It is what I supposed. Senior-White [27] refers to this as "Parker's synonymy," but I believe it must have been communicated in correspondence, as I can not find that Parker ever published it. From the excellent figure, I believe that the same species was described as *Sarcophaga argentina* by Brethes [28]; he cites also some references to the same species as *nurus* Rondani, from Argentina.

Sarcophaga dux, p. 534.

One male, Honolulu. As I expected, this is the same as *Sarcophaga harpax* Boettcher [29] I had received both sexes from Honolulu in 1917 from Doctor Illingworth, which convinced me of the synonymy. Parker has announced the same conclusion.[30] I did not spread the genitalia of the Thomson type, but have other males from Honolulu in the National Museum which have been spread.

Sarcophaga pallinervis, p. 535.

One male, one female. Undoubtedly the same as *Sarcophaga communis* Parker, 1914. The oldest name for the species which I found

[24] Proc. U. S. Nat. Mus., vol. 43, 1912, p. 357.
[25] Proc. Ent. Soc. Wash., vol. 20, 1918, p. 20.
[26] Revue Entom., vol. 15, 1896, p. 185.
[27] Records Ind. Mus., vol. 26, 1924, p. 261.
[28] Anales Mus. Nac. Buenos Aires, vol. 28, 1916, p. 142.
[29] Deutsche Ent. Zeitsch., 1913, p. 735.
[30] Bull. Brooklyn Ent. Soc., vol. 14, 1919, p. 41.

is *Sarcophaga lherminieri* Robineau-Desvoidy;[31] he described it from Carolina as a Myophora. The identity of *communis* with *pallinervis* was well established from Thomson's description, together with specimens of both sexes from Honolulu; it was mentioned by Hall.[32]

Sarcophaga obtusifrons, p. 536.

Two females, Galapagos Islands. These belong to the *Oxysarcodexia* group, in which females are very difficult or impossible to place. The United States National Museum has a series of two males and six females collected on the Galapagos Islands in 1899, of which the females agree with Thomson's description and types; we may therefore assume with some confidence that the males belong to *obtusifrons*. They are the same as a series from Samoa identified by Malloch as *taitensis* Schiner[33] where he shows by a figure slight differences between *peltata* and *taitensis*, which I had previously decided to be identical. I believe *taitensis* is correctly identified here by him. Schiner described the species.[34] It has been customary to give the Novara Reise priority over Eugenies Resa; but Kahl has discussed the point in Annals of the Carnegie Museum (vol. 11, 1917, p. 393), making out that the latter may have appeared in 1868. *Taitensis* (including *obtusifrons*) and *peltata* are the only species of the *Oxysarcodexia* group so far known in which the males have any recognizable villosity on the inner side of the hind tibiae. The forceps in *peltata* are wide in the middle when viewed from behind, while those of *taitensis* are narrow.

Sarcophaga nobilis, p. 536.

Two females, Montevideo and Buenos Aires; the male mentioned by Thomson not now in the collection. A synonym of *varia* Walker

Sarcophaga canescens, p. 539.

One female, which is the female of his *Tricharaea scatophagina* described on p. 541. This is a synonym of Wiedemann's *Tachina brevicornis*[35] the type of which I described under the new generic name Mallonotum.[36] Walker's *?Dexia albicans*[37] is also the same; and Townsend writes me that he also described the genus and species as *Leucoravinia quadraticephala*.[38] It results from all this that that species should be known as *Tricharaca brevicornis* Wiedemann. It belongs to the Sarcophagidae.

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[31] Myodaires, 1830, p. 339.
[32] Annals Ent. Soc. Amer., vol. 21, 1929, p. 331.
[33] Ann. Mag. Nat. Hist., ser. 10, vol. 4, 1929, p. 256.
[34] Novara Reise, 1868, p. 314.
[35] Auss. Zweif. Ins., vol. 2, 1830, p. 299.
[36] Annals Ent. Soc. Amer., vol. 18, 1925, p. 299.
[37] Trans. Ent. Soc. London, n. ser., vol. 4, 1858, p. 204.
[38] Wiener Ent. Zeit., vol. 44, 1928, p. 143.

Sarcophaga brevispina, p. 539.

One female, Rio Janeiro. A synonym of *Sarothromyia femoralis* Schiner,[39] which was described as a *Sarcophila*.

Sarcophaga genalis, p. 539.

One female, Brazil. Very nearly identical with *Sarcophaga rapax* Walker (*helicis* Townsend) of North America; I could not quite assert that it is the same, not having a male type, and no identified specimens to compare. *S. rapax* has priority, and it would be best to regard this as a synonym, at least until males from Brazil are found which show differences.

Sarcophaga despecta, p. 540.

One male, Puna (an island in the Gulf of Guayaquil); three females from Panama are different, two of them being *Sarcophagula occidua* Fabricius, the other, mentioned as a variety by Thomson, having a closed apical and possibly not the same. The male is not in good condition and I could make nothing tangible out of it. In order to dispose of the species, I restrict it to the two females which are the same as *occidua*.

SPECIES OF VAN DER WULP

IN BIOLOGIA CENTRALI-AMERICANA, DIPTERA, VOL. 2. AS FAR AS P. 272 THIS WAS PUBLISHED IN 1895, THE REMAINDER IN 1896

Sarcophaga villipes, p. 269, pl. 7, fig. 2.

One male, three females. This species was described as *Sabinata catalina* by Parker.[40] Types of *catalina* are in the National Museum, and I had a spread authentic specimen with me and compared it with the spread male type. I misidentified *villipes* in Sarcophaga and Allies, (1916, p. 178); suspecting this, Townsend proposed the name *knabi*, new species for my specimens.[41]

Sarcophaga rufitibia, p. 270, pl. 7, fig. 3.

Four males. I renamed this species as *Sthenopyga globosa* in Sarcophaga and Allies (1916, p. 59). It is the type species of *Sthenopyga*, and does not belong to *Sarcophaga*.

Sarcophaga vagabunda, p. 270, pl. 7, fig. 4.

Twelve specimens of both sexes. I exclude one female, which is *helicis* Townsend, and the rest are all *stimulans* Walker (*quadrisetosa* Coquillett).

Sarcophaga acanthoptera, p. 271, pl. 7, fig. 5.

One male, three females. Allied to *helicis*, having the first vein hairy and three dorsocentrals.

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[39] Novara, 1868, p. 315.
[40] Bull. Brooklyn Ent. Soc., vol. 16, 1921, p. 112.
[41] Proc. Biol. Soc. Wash., vol. 30, 1917, p. 45.

Male.—Head as in *helicis*, but outer verticals developed, face more receding, back of head more bulging below. Thorax also the same, but apical scutellars depressed, not decussate. Abdomen more keeled below, with uniform pollen on venter; dorsum quite different, the pollen not so glistening and tessellated, a median stripe and vague hind parts of second and third black, pollen elsewhere slightly yellowish. No median marginals on first and second abdominal segments, third with a pair median and two lateral, fourth with marginal row. Fourth reddish in ground color; first genital segment retracted, apparently dark; second genital red, with a row of short bristles near base. Genitalia as in Figure 7. Forceps red to about middle, straight and narrow in back view, diverging a little in middle and coming together again. Claspers black, not unusual; penis small, stalked, concave in front and with a pair of small processes. Legs black, mid tibia with two bristles on outer front side, hind tibiae not villous. Wing hyaline, costal spine well developed.

Sarcophaga xanthopyga, p. 271.

Male and female, 17 specimens. Is the same as *effrenata* Walker.[42]

Sarcophaga conjugens, p. 272.

Two males. Like the preceding, this is a synonym of *effrenata* Walker.

Sarcophaga stellata, p. 272.

Seven males, two females. I spread the genitalia of all the males, belonging to four species. I restrict the species to three males, from Amula, Omilteme, and Mexico City, which are the same as *rapax* Walker (*helicis* Townsend, a common North American species). Of the specimens excluded, one is *debilis*, one *surrubea*, and two others are undetermined species but not in suitable condition for designation as types.

Sarcophaga surrubea, p. 273.

One male. A second specimen is one of the cotypes of *stellata*. Three dorsocentrals, male without villosity on hind tibiae, genital segments red (Group D of Sarcophaga and Allies); first vein hairy, tibiae black, first genital segment ordinary; abdomen black except hind margin of fourth segment; penis not flask-shaped (this much runs to couplet 29, Sarcophaga and Allies (p. 116), but it is not my *surrubea* of couplet 30). It is not *biseriata* nor anything I have seen. Genitalia as in Figure 8, the rows of spines on the lateral lobes of the penis as figured seem very striking.

[42] *Adamsi* Hall, Annals Ent. Soc. Amer., vol. 21, 1928, p. 345, figs.

As the supposed *surrubea* of my Sarcophaga and Allies, 1916, (p. 154), is a different species and was not found among the types examined in Europe, I now propose for it the name

SARCOPHAGA MORIONELLA, new species

Sarcophaga surrubea ALDRICH, Sarcophaga and Allies, 1916, p. 154 (not of Van der Wulp)

Type series, nine males and seventeen females, Havana, Cuba (C. F. Baker).

Type.—Male, Cat. No. 43063, U.S.N.M.

Sarcophaga plumigera, p. 273.

Two males, three females. Excluding a male from Teapa, which is *fuscianalis* and not mentioned from that locality by Van der Wulp, the remainder seem to be a single species, and belong to the genus *Notochaeta;* they will be considered later under that genus. They are not the same as described by me under *Notochaeta* in Sarcophaga and Allies (1916, p. 55), and I now propose for the latter, the name

NOTOCHAETA HINEI, new species

Notochaeta plumigera ALDRICH, Sarcophaga and Allies, 1916, p. 55 (not of Van der Wulp)

Type.—Male, Cat. No. 43064, U.S.N.M. from Puerto Barrios, Guatemala (J. S. Hine).

Sarcophaga ventricosa, p. 274.

Two males. This is the species which I erroneously accepted as *assidua* Walker in Sarcophaga and Allies (1916, p. 285, fig. 137).

Sarcophaga diversinervis, p. 274, pl. 7, fig. 7.

One male, one female. I exclude the female, which is a *Sarcophaga*, and restrict the species to the male, which is a *Notochaeta* and will be discussed in a later paper.

Sarcophaga fuscianalis, p. 275.

Nine males and females. It is *Notochaeta*, the same species described by me as *Notochaeta subpolita* in Sarcophaga and Allies (1916, p. 53), with figure of genitalia.

Sarcophaga praevolans, p. 275, pl. 7, fig. 8.

Two males, one female. The males are alike, and belong to the *Boettcheria* group.[43] The female (Orizaba) is not of this group, and I exclude it.

Male.—Dorsocentrals three, all sternites wide, hind femur with a median row of bristles as in *cimbicis*, anterior crossvein with

[43] *Boettcheria*, Parker, Proc. Boston Soc. Nat. Hist., vol. 35, 1914, p. 65.

a cloud. Pollen of head and abdomen old gold in color; fifth sternite retracted in the spread specimen; no median marginals on second segment; sternopleural 2, 1. Middle tibia with one bristle on outer front side, hind tibia (fig. 9*b*) with very dense, villous hair on inner side; hind femur attached to trochanter at an angle, trochanter with stubby spines on lower hind edge. Leg more decidely bent at base than in *cimbicis*, and femur more slender. Forceps from behind (fig. 9*a*) very distinctive; penis like that of *cimbicis* as far as I can see.

Enderlein has made this species the type of his new genus *Dasyproctia*,[44] but this genus can not be more than a synonym of *Boettcheria* as it is very close to the type species of the latter, *latisterna* Parker.

Sarcophaga setulosa, p. 276.

One male. This is a rather small specimen of *cimbicis* Townsend,[45] which was fully redescribed by Parker under the name *Boettcheria fernaldi*[46] with figures. I have examined types of all.

Sarcophaga turbata, p. 276.

One male, four females. One female (Orizaba) has been correctly set apart by Austen as a different species and I exclude it. The male has three dorsocentrals, hind tibiae not villous, genital segments red; first vein bare; palpi black; anterior acrostichals well developed; and runs to *rudis* on page 114 of Sarcophaga and Allies, but differs in the genitalia at least. There are one or two slender hairs on the inner side of the hind tibia, suggesting the beginning of villosity. The head and last two abdominal segments have golden pollen; first and second segments with median stripe which hardly extends upon third; third and fourth on venter with long pile, some of which is pale, the fourth black in ground color. Sternopleural 2, 1; scutellum damaged, but at least with good-sized apicals. Cheek over one-fourth eye height; parafacial hairs all minute. Genitalia as in Figure 10. First genital segment a little brown on sides, with no distinct bristles; second red with a few bristly hairs.

Turbata is designated the type of *Dienchaeta* new genus by Enderlein (1928, p. 16); unfortunately I did not have his paper at hand and can not confirm the existence of the principal character he uses to define the genus—the presence of two pairs of lateral scutellars.

Sarcophaga trivialis, p. 277.

Seventeen males, nine females. I spread the genitalia of all males, and sorted them into *ten species*. One belong to the *Boett-*

[44] Arch. f. Klass. u. Phyl. Ent., vol. 1, 1928, p. 23.
[45] Canad. Ent., vol. 24, 1892, p. 126.
[46] Proc. Boston Soc. Nat. Hist., vol. 35, 1914, p. 72.

cheria group, two to the *Ravinia*, the other seven to the *Oxysarcodexia*. I restrict the species to three males of the last-named group from Amula and one from Atoyac, so indicated in the collection; four females from Amula are presumed to be the same.

Male.—Runs to *bakeri* in Sarcophaga and Allies (1916, p. 247), differing chiefly in having the forceps close together to tip. Like *bakeri*, it has a pair of distinct apical scutellars, which do not occur in many of the group. Pollen of head yellow, abdomen with deep yellow pollen on fourth segment, more gray basally. Fifth sternite small, not prominent, yellow, divided into two slightly swollen lobes. Genitalia as in Figure 11. The forceps with an oblique toothlike tip as seen in profile.

Sarcophaga uncata, p. 277.

Three males. Excluding one male from Northern Yucatan, which is *caridei* Brethes (*angustifrons* Aldrich) and restricting the species to the other two, it is the same as my *marginata*,[47] which sinks as a synonym.

Sarcophaga errabunda, p. 278.

Seven males. I exclude two specimens of *sternodontis* (Teapa and Chilpancingo), and one belonging to the *Acridiophaga* group (Amula); the other four are all one species, to which I restrict the species. It is well described and figured by Hall under the name *reinhardii*.[48]

Sarcophaga pusiola, p. 278.

One male, three females. I exclude two females (Tepetlapa, Orizaba) which have the first vein setulose. The male and the other female, both from Mexico City, to which I restrict the species, are the same species described as *Ravinia peniculata* by Parker.[49] I compared a specimen of *peniculata* determined by Parker.

Sarcophaga debilis, p. 279.

One male, three females. Two of the latter are *Sarcophaga rapax* Walker, and I exclude them, restricting the species to the others, which are close to *rapax* but less silvery; the male shows good genitalic differences, while the female has the genital segments blackish and pollinose. Genitalia as in Figure 12. Forceps yellow to tip, flat behind, blunt, small. Penis with short stalk, and large, complicated, globose head. A second male of *debilis* is found among the cotypes of *stellata*.

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[47] Sarcophaga and Allies, 1916, p. 136.
[48] Annals Ent. Soc. Amer., vol. 21, 1928, p. 346.
[49] Proc. Boston Soc. Nat. Hist., vol. 35, 1914, p. 21, figs.

Sarcophaga micropyga, p. 279.

Six males. One I exclude as a different species, restricting the species to the other five. A species of *Notochaeta*, to be considered in a later paper.

Sarcophaga claripalpis, p. 280.

One male, four females. One female I exclude, a species of *Sarcophaga;* the remainder do not belong to the Sarcophagidae, but are the species described by Townsend as *Paratheresia signifera*.[50] I have discussed the habits, distribution, and in part the synonomy, under Townsend's name.[51]

Sarcophaga sueta, p. 281

Three males, of which I spread two. It is the same species which I described later as *Sarcophaga communis*, var. *ochracea*.[52] Hall recognized it as a distinct species under the name *Sarcophaga ochracea*.[53]

Sarcophaga tridens, p. 281.

Six males, one female. The males are the same as *uncata* Van der Wulp. I spread four, the two unspread males and the female are apparently the same.

Sarcophaga deleta, p. 282.

One male, new to me. Dorsocentral three, first vein bare, genital segments red, hind tibiae not villous; anterior acrostichals well developed: an apical scutellar on one side, none on the other; middle tibia with one bristle on outer front side. Genitalia (fig. 13) very characteristic; the forceps black, divergent, strongly curved forward, with a black lateral process near base, and a row of backwardly directed stiff spines at the basal limit of the black part; a similar tuft standing out from the tip of the lateral process.

Sarcophaga tenuiventris, p. 282.

Two males. The same as *ventricosa* Van der Wulp (p. 274) (*assidua* Aldrich, not Walker).

Saracophaga oberrans, p. 283.

One male, two females. Both females belong to *Notochaeta micropyga* and I exclude them, restricting the species to the male. It belongs to the *Acridiophaga* group, but seems distinct from those described by me. The forceps are as in *marginata*, but the penis in its last joint has no appreciable side pieces at all, being in the form of a tapering tube with slight lateral protuberances. Dorsocentrals four,

[50] Journ. New York Ent. Soc., vol. 23, 1915, p. 65.
[51] Proc. Ent. Soc. Wash., vol. 31, 1929, p. 33.
[52] Sarcophaga and Allies, 1916, p. 255, fig. 121.
[53] Annals Ent. Soc. Amer., vol. 21, 1928, p. 340, figs.

but the second small, so it may go in the section with three, as the other *Acridiophagas* do. Anterior acrostichal of quite striking length; apical scutellars long, decussate, a little upcurved; second abdominal without median marginals, one pair on third; fourth abdominal largely red in ground color. Genitalia as in Figure 14. Runs in the keys in Sarcophaga and Allies to couplet 22 (p. 115), if considered to have three dorsocentrals, and to couplet 13 (p. 246), if considered to have four.

Sarcophaga triplasia, p. 283, pl. 7, fig. 10.

One male, three females. One female (Amula) has been indicated as distinct by Major Austen. Excluding this the others seem to be alike, and are the variety of *fulvipes* with black legs, described by Parker as *fulvipes* var. *dissidia*.[54] Although the status of *fulvipes* Macquart is a little uncertain, the close resemblance of the present form to the species as identified by authors seems to justify calling this a variety of it.

Sarophaga tripartita, p. 284.

One male. The same as *Sarcophaga plinthopyga* Wiedmann, 1830.[55]

Sarcophaga pexata, p. 284.

Four males, one female. Excluding two males of a different but related species, I restrict the species to two males from Yucatan. The female is probably a third species. As restricted the species fits into the *Paraphrissopodia* group of Townsend, with *hillifera*, etc. The nearest form in genitalic structure is *otiosa* Williston, which however has much longer and narrower forceps, and lacks the first pair of processes on the front side of the penis. Figure 15 shows the structure in *pexata*.

Sarcophaga volucris, p. 285.

Two males, of two species, both with striking genitalia as different as possible. One (Teapa) is *occipitalis* Thomson (*cotyledonea* Aldrich, *auribarbata* Townsend), and I exclude this, restricting the species to the other, from Atoyac. There are four or more dorsocentrals, only the hindmost two of normal size; hind tibiae thinly but evidently villous both sides; genital segments red; first vein bare; no anterior acrostichals; sternopleurals three; apical scutellars small but distinct. Back of head with two rows of black hairs below, three above. Second abdominal segment without median marginals, third with one pair; fourth segment yellow in ground color

[54] Canad. Ent., vol. 49, 1917, p. 157, fig.

[55] *Robusta* Aldrich, Sarcophaga and Allies, 1916, p. 268; syn. by Aldrich, Annals Ent. Soc. Amer. vol. 17, 1924, p. 210.

on apical half. Middle tibia with long villosity from before middle, and one bristle on outer front side.

Genitalia (fig. 16) large: forceps black, large, strongly curved, with dense retrorse, short hair behind, a few more bristly near tip, which is suddenly reduced to a small curved thorn; penis red, long, with a large apical hook directed forward. I have not seen this species before: it will be easily recognized from the genitalia.

Sarcophaga ochripyga, p. 285.

Two males, four females. A male from Frontera and a female from Tepetlapa were set apart by Doctor Townsend on his recent visit and both labeled "*Oxysarcodexia obtusifrons* Thomson." This species was described from two females, locality Galapagos Islands, and is with little doubt the same as *Sarcophaga taitensis* Schiner, the latter having priority as generally considered of one year. Schiner's species has not as yet been definitely identified from other regions than the islands of the Pacific, hence I doubt Townsend's identification. I therefore restrict the species to the other male, of which my *australis* is a synonym.[56]

Sarcophaga aequata, p. 286.

Two males of two species. I exclude the one from Teapa, which is nearly related to *amoena* Aldrich, and restrict the species to the one from Amula, which is a species new to me.

Male.—Hind tibia with four or five short, slender villous hairs, hardly could be called villous at all; genital segments red: dorsocentral four (or five). Head light golden pollinose; front narrow above; antennae and palpi black; mesonotum with three distinct black stripes and four golden ones; abdomen golden on sides, tessellated; second abdominal segment without median marginals, third with a pair. Middle tibia with one bristle on outer front side. Acrostichal hairlike, but a little coarse. Genitalia as in Figure 17. The peculiar forceps should be instantly recognizable; they are black and have three spines as shown. The accessory plate (outer forceps) is black apically, while the penis is yellow dorsally, brown ventrally.

Sarcophaga afficta, p. 286.

Nine males, one female. Apparently all the same species. Another male, from Rio Paragai, Guerrero, and not listed by Van der Wulp, has a type label, but is a different species. I disregard this specimen. The species belongs to the *Oxysarcodexia* group, with genitalic characters different from all known to me. The fifth sternite produced in two long, slender, parallel arms, about as in *timida* but more slender. The forceps viewed from behind are wide and con-

[56] Sarcophaga and Allies, 1916, p. 282, fig. 135.

tiguous at tip, and have a distinct concavity behind in the middle, not reaching the sides; they are yellow, and at tip there is a transverse black flattened diagonal margin, from about the middle of which on each side a minute tooth projects backward. See Figure 18. I can not match this species in the United States National Museum.

Enderlein has designated this species as type of his new genus *Ctenoprosballia*.[57] It seems to me that the genus is a synonym of *Oxysarcodexia* Townsend, and this has not much more than group standing.

WILLISTON'S SARCOPHAGAS

IN TRANSACTIONS OF THE ENTOMOLOGICAL SOCIETY OF LONDON, 1896

Sarcophaga micropygialis, p. 363.

Nine males. Postsutural dorsocentrals four; hind tibiae not villous; genital segments black; first vein bare; middle femur not with comb; cheek with pale beard before the metacephalic suture. These characters come out at *servilis* Aldrich on page 236 of Sarcophaga and Allies, but the species is distinct on genitalic characters. Genitalia as in Figure 19. The penis is yellow, slender, elbowed, and greatly surpasses the forceps, which are small, blackish, flat behind, the apices narrow and not divaricate.

Sarcophaga concinnata, p. 364.

Three males, one female. As Williston says, this is just like *otiosa* except in not having villosity on hind and middle tibiae, and in being smaller. I was surprised to find that the similarity extends to the genitalia, which seem identical. It is doubtful if this can be regarded as more than a variety of *otiosa*.

Sarcophaga otiosa, p. 364.

Three males, one female. Williston retained a pair of the cotypes, which ultimately passed to the American Museum of Natural History, where I found them and published a description in Sarcophaga and Allies (1916, p. 213, fig. 101). My sketch of the genitalia was a poor one, and I here add in Figure 20 one which is a little better. The species is close to *pexata* Van der Wulp, but the forceps are much more slender with the outer concavity very small, and the penis lacks the first pair of anterior appendages occurring in the latter.

Sarcophaga pavida, p. 365.

Two males, one female. A synonym of *sternodontis* Townsend, a very widespread tropical and subtropical species; I redescribed it in Sarcophaga and Allies (1916, p. 265, fig. 127). In the Williston

[57] Arch. f. Klass. u. Phyl. Ent., vol. 1, 1928, p. 28.

types the pollen of the frons is yellow, not so deep golden as in some specimens, but about as in the type of *sternodontis*.

Sarcophaga chaetopygialis, p. 366.

Numerous specimens, of two species. I restrict the species to the one described by me from a series of cotypes in the American Museum of Natural History,[58] which is represented here also. It belongs to the *Oxysarcodexia* group, and is the only one of these known which has hairs on the first vein, there are usually only two or three of these hairs or setules.

EXPLANATION OF PLATES

Plate 1

Figure 1. *S. varia* Walker. *a*, penis, from behind; *b*, male genitalia, from side
2. *S. violenta* Walker. *a*, genitalia, from side; *b*, forceps, from behind.
3. *S. aurifinis* Walker. Penis, from side.
4. *S. bifrons* Walker. Genitalia, from side.
5. *S. assidua* Walker. *a*, genitalia, from side; *b*, forceps, from behind; *c*, tip of penis, from side; *d*, fifth sternite.
6. *S. perneta* Walker. Genitalia, from side.
7. *S. acanthoptera* Van der Wulp. Genitalia, from side; and forceps, from behind.
8. *S. surrubea* Van der Wulp. a, genitalia, from side; *b*, penis, from behind.
9. *S. praevolans* Van der Wulp. *a*, forceps, from behind; *b*, hind tibia of male.
10. *S. turbata* Van der Wulp. *a*, genitalia, from side; *b*, forceps, from behind.
11. *S. trivialis* Van der Wulp. *a*, penis, from side; *b*, forceps, from side; *c*, forceps, from behind.

Plate 2

12. *S. debilis* Van der Wulp. *a*, genitalia, from side; *b*, forceps, from behind.
13. *S. delecta* Van der Wulp. *a*, forceps, from behind; *b*, penis, from side; *c*, forceps, from side.
14. *S. oberrans* Van der Wulp. *a*, terminal joint of penis, from behind; *b*, genitalia, from side.
15. *S. pexata* Van der Wulp. *a*, genitalia, from side; *b*, forceps, from behind.
16. *S. volucris* Van der Wulp. *a*, genitalia, from side; *b*, forceps, from behind, less magnified.
17. *S. aequata* Van der Wulp. Genitalia, from side.
18. *S. afficta* Van der Wulp. *a*, genitalia, from side; *b*, forceps, from behind.
19. *S. micropygialis* Williston. *a*, genitalia, from side; *b*, forceps, from behind.
20. *S. otiosa* Williston. *a*, genitalia, from side; *b*, forceps, from behind.

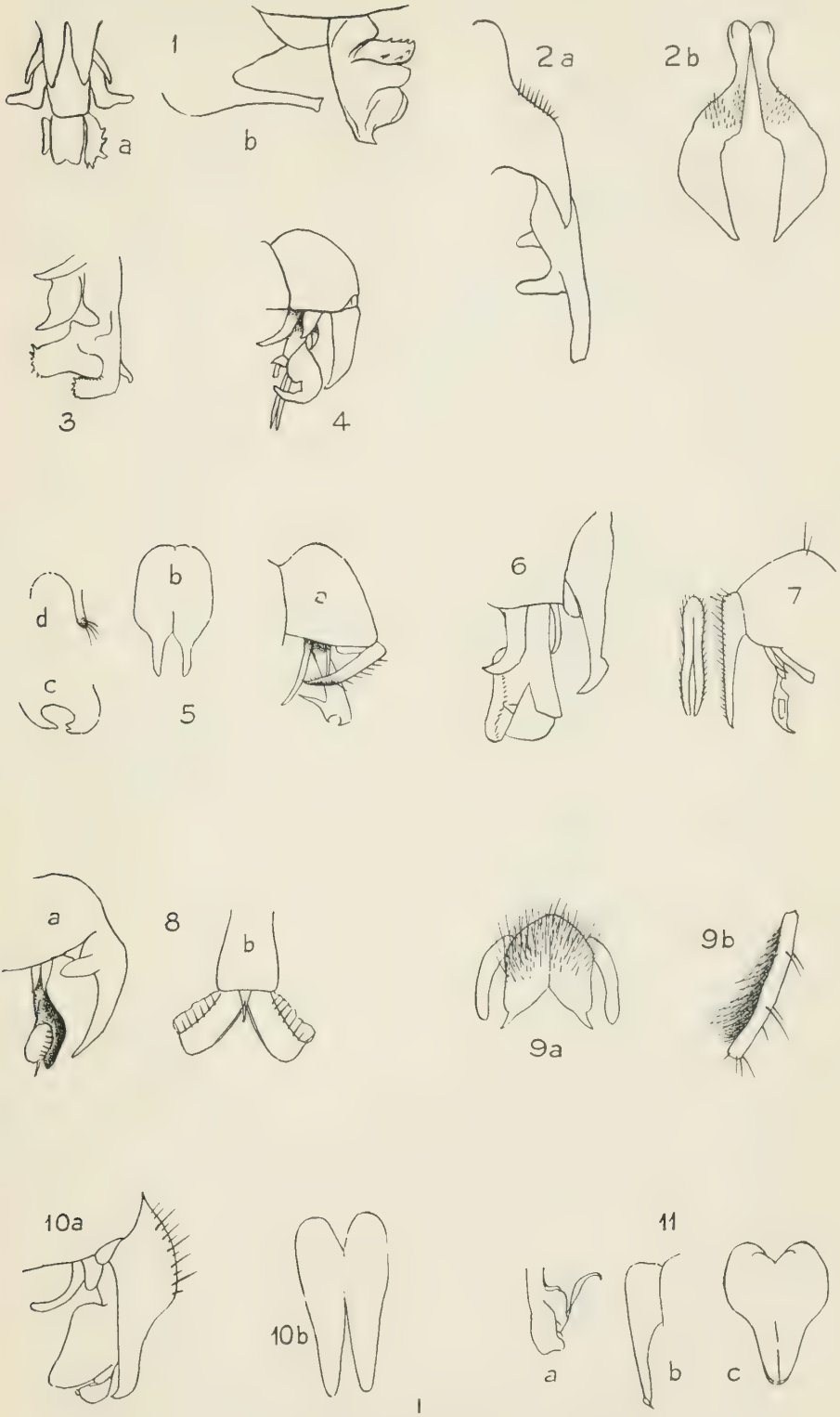
[58] Sarcophaga and Allies, 1916, p. 110, fig. 45.

PLATE 3

Each figure shows the male genitalia from left, with a rear view of the forceps at the right. All drawn by Mrs. Eleanor A. Carlin.

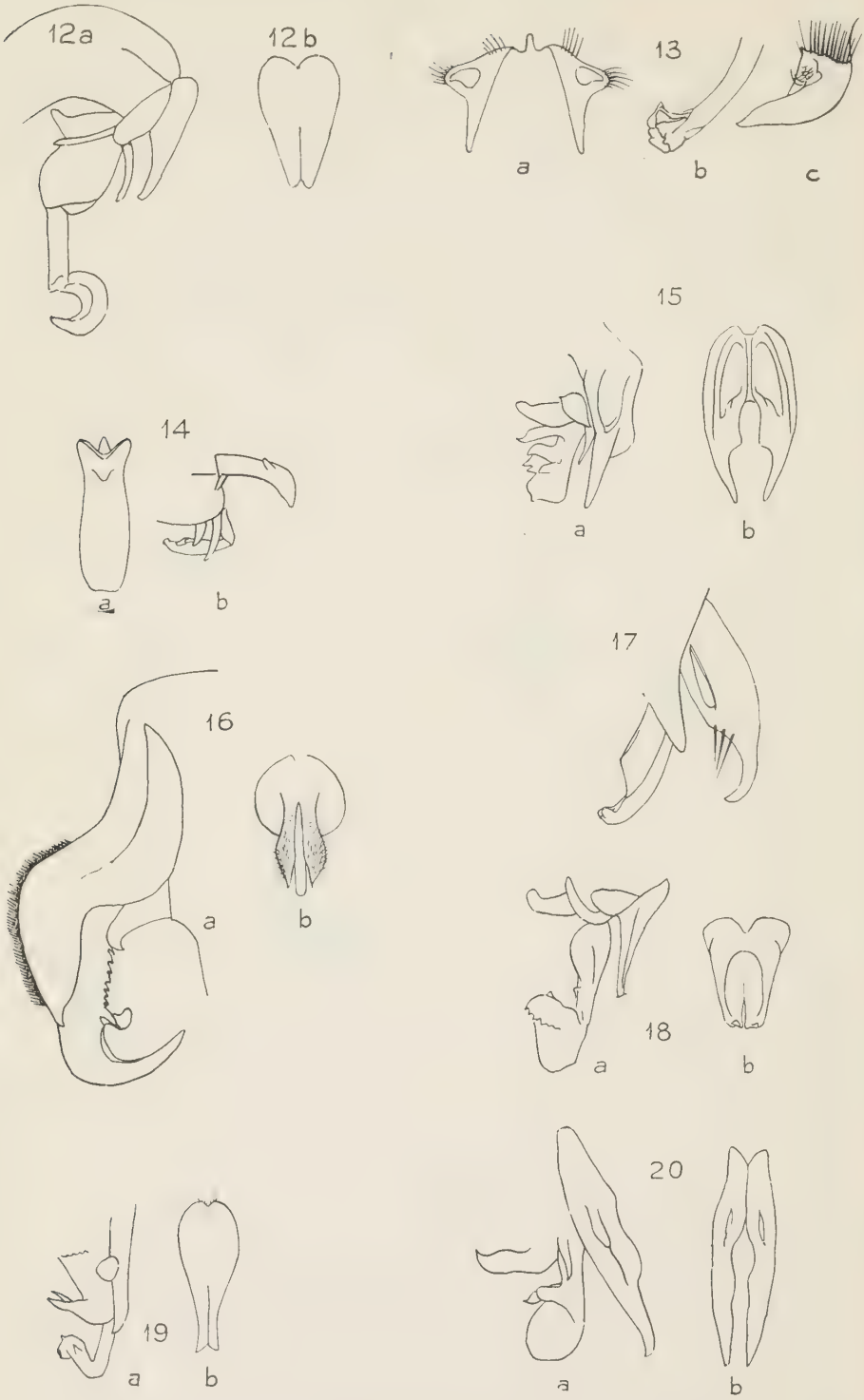
FIGURE 21. *S. opima* Wiedemann.
22. *S. tessellata* Fabricius.
23. *S. xanthophora* Schiner.
24. *Tripanurga albicans* Wiedemann.
25. *S. dimidiata* Wiedemann .
26. *S. amorosa* Schiner.
27. *S. rufiventris* Wiedemann.

U. S. GOVERNMENT PRINTING OFFICE: 1930



GENITALIA OF FLIES OF THE GENUS SARCOPHAGA

FOR EXPLANATION OF PLATE SEE PAGE 38.



GENITALIA OF FLIES OF THE GENUS SARCOPHAGA

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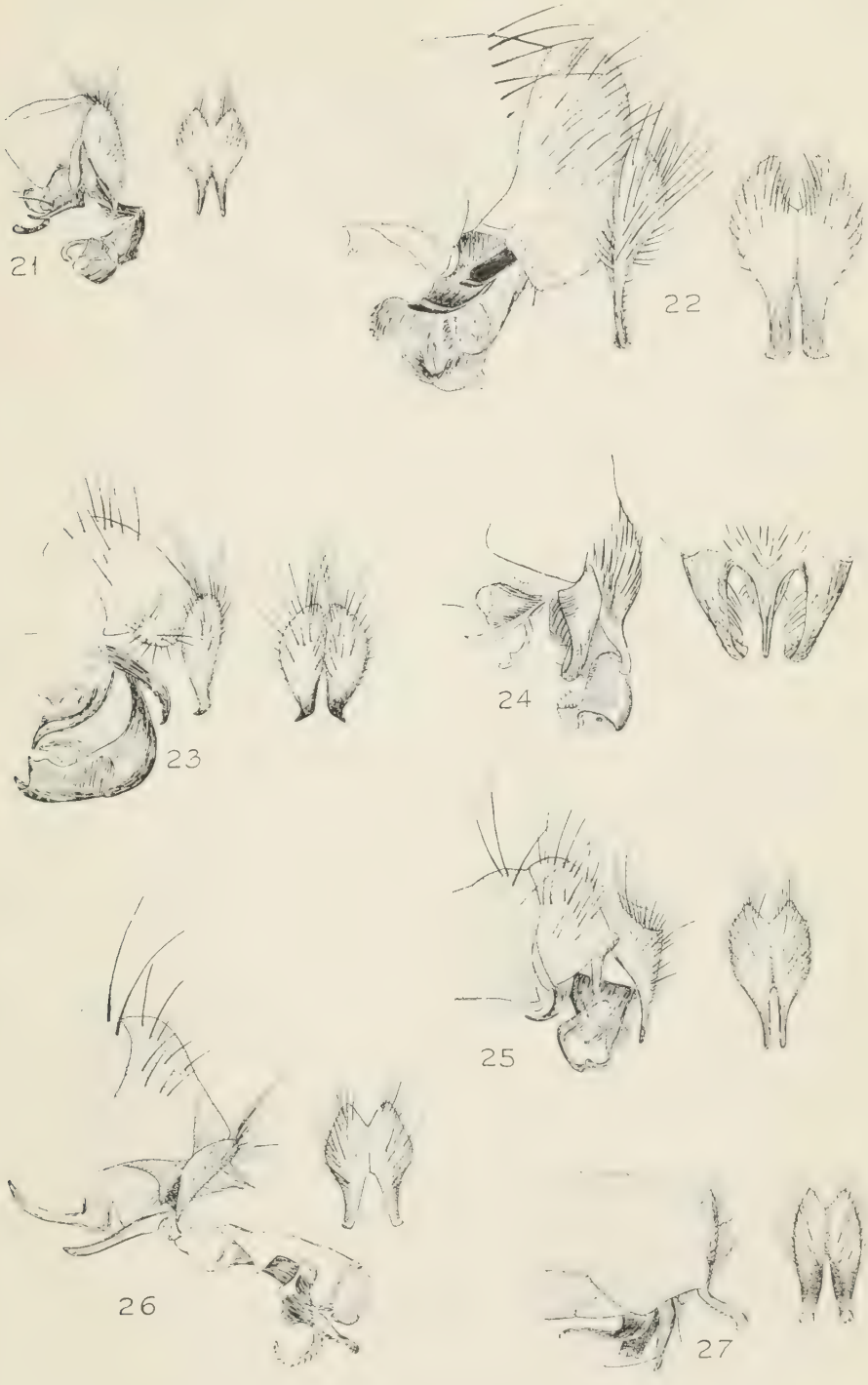


GENITALIA OF FLIES OF THE GENUS SARCOPHAGA

FOR EXPLANATION OF PLATE SEE PAGE 39.

EXPLORATION OF RUINS IN THE WHITE MOUNTAIN APACHE INDIAN RESERVATION, ARIZONA

By Walter Hough

Head Curator of Anthropology, United States National Museum

HISTORY

A reconnaissance of ruins in Arizona for the Bureau of American Ethnology in 1918, an account of which is appended, led to the selection of a large, ancient pueblo in the northwestern part of the White Mountain Apache Reservation for exploration. In 1919 this ruin, called by the Apache *Nas tsuggi toeda*, Grasshopper Spring, was examined as thoroughly as the small funds permitted. Through the kindness of Mr. and Mrs. S. W. Jaques of Lakeside, Ariz., who furnished transportation to the distant site, the work was much expedited. The results of this exploration, unpublished in the expectation of further work on the ruin, are now given in their incompleteness as containing data of importance concerning this unknown region. A brief summary of the work on the project was published in the 1919 number of Smithsonian Miscellaneous Collections.[1]

Geography, Geology, and Biology.—The country west of Cibicue to Oak Creek is topographically strongly diversified, being cut with deep canyons and interspersed with high mountains and parks. West of Cibicue the rocks are limestone and sandstone of the Pennsylvania series, and these rocks prevail at Grasshopper, the limestone being highly fossiliferous. The sandstone is bright red and dividing easily into slabs of varying thickness. The walls of the ruins were built of these materials, principally of gray limestone. In several ruins of the group the central buildings were of red sandstone and the surrounding rooms of limestone, an evidence of intentional village planning.

Biology—Plants.—The country about Grasshopper Valley is forested with *Pinus ponderosa*, *Juniperus occidentalis*, cedars, walnut, oak, and a few trees of other species. The brush common to the open

[1] Volume 72, No. 1, pp. 64–66, and in Volume 70, No. 2, pp. 90–93.

country is principally of rhus and acacia, yucca, dasylirion, agave, and other desert plants, often occurring over large areas.

Biology—Mammals.—The natural wild animals are deer, bear, wolves, fox, coyote, wildcat, raccoon, beaver, porcupine, rabbit, and smaller life. These animals are relatively abundant owing to the wildness and inaccessibility of the region, from the fact that Indians

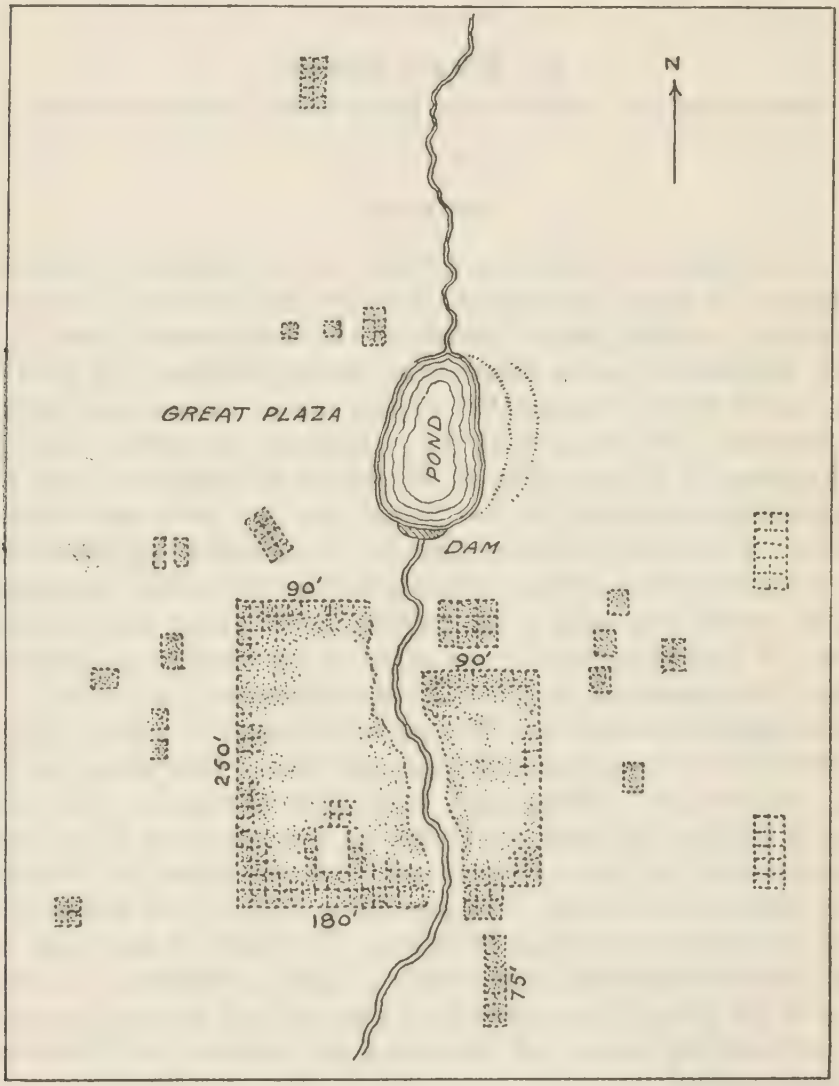


FIGURE 1.—GENERAL SKETCH OF RUINS IN GROUP

hunted with bows and arrows, and the fortunate event that the whole territory was set apart as a reservation.

Mammal bones from the ruins and identified by Dr. Gerrit S. Miller, jr., are: Mule deer, lynx, bear, wolf, jack rabbit, and dog.

Human remains.—The cemetery areas shaded on the plan (fig. 5) yielded little material. Evidently they were mere burial plots of

the adjoining smaller houses. The larger cemetery, if it exists, was not found. The burials were at full length and not more than 40 inches deep. Only a few burials had mortuary offerings of pottery or other objects.

Dr. Ales Hrdlicka reports that the majority of the skulls are of the oblong type like those coming from the Gila. This corroborates the prevalence of Gila and other southern pottery types in the culture remains.

Birds.—There is abundance of bird life in the region. As noticed in remarks on mammals, the setting apart of the reservation has aided in their preservation. The birds generally noted are jays, large wild pigeon, plover, hawks, eagles, turkey, and quail. Bones collected in the débris of ruins and identified by Dr. A. Wetmore are the ferruginous rough legged hawk, *Triochis regalis*, the red tailed hawk, *Buteo borealis*, the turkey buzzard, and the raven, *Corvus corax*. Turkey bones were plentiful, but it is most probable that these birds were preserved for their feathers and not eaten.

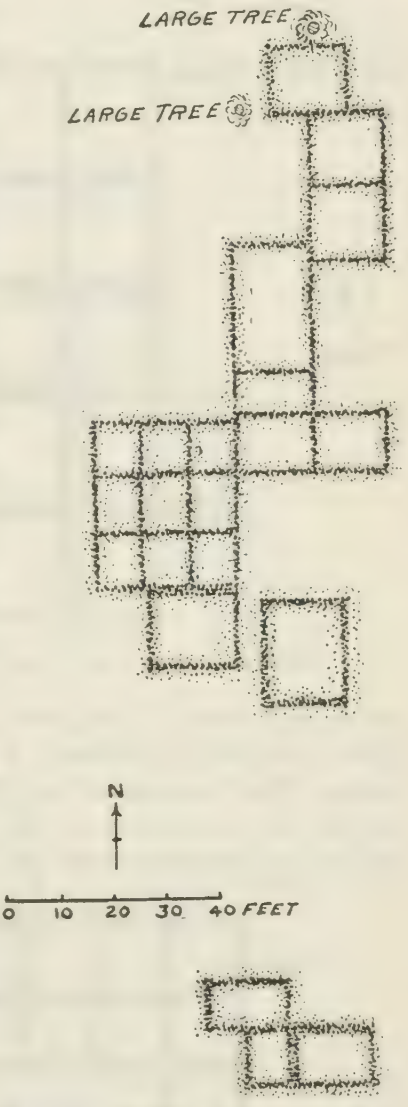


FIGURE 2.—SKETCH OF INDIVIDUAL RUIN

DESCRIPTION OF RUINS

The location of the Grasshopper sites was determined by the strong and permanent spring, the basin-like area in which water could be impounded, the excellent land available for cultivation, and the supply of wood for fuel, together with the good conditions for an abundance of game. Beams and stone for building and flint for various implements were also factors of advantage.

The Grasshopper ruins consist of a great house located near the spring and water channel, and a number of sites of the groups more or less distant. The great house is in two wards lying in compact masses on either side of the rivulet called Salt River Draw. The mounds are covered with squaw brush, and walnut, with here and there a juniper and pine (pl. 1, *b* and *c*). The chief outstanding

features of the west village is a court near the south end, 90 by 140 feet, connected with a small plaza. This ward of the village covers more than an acre and was four, perhaps five, stories in height. The east ward is more than half an acre in area. North of the west ward is a plaza 300 feet long, flanked in part on the east by an isolated clan house of 18 rooms, well planned. Six ruins in the cluster may be regarded as clan houses, sketch plans of which are figures 2–4. They differ in size and arrangement of rooms; in general they show considerable skill possessed by the architects who planned them (fig. 1).

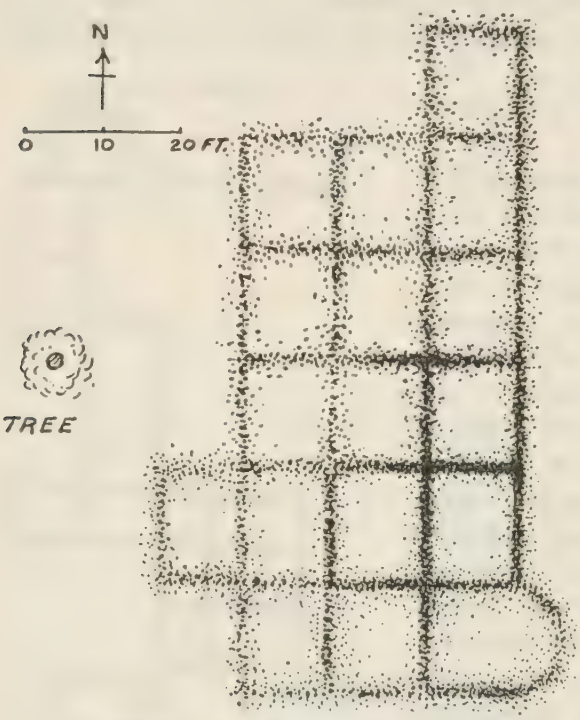


Figure 3.—Sketch of Individual Ruin

A third form of building consists of large rectangular areas outlined with building stones. These are seen scattered over the level ground, principally west of the great pueblo (fig. 5). Observers have called them "unfinished houses," but they are more likely the bases of sheds. The foundations are four or five courses of masonry and do not go down more than 18 inches, showing that they did not support any heavy superstructure (pl. 1*a*).

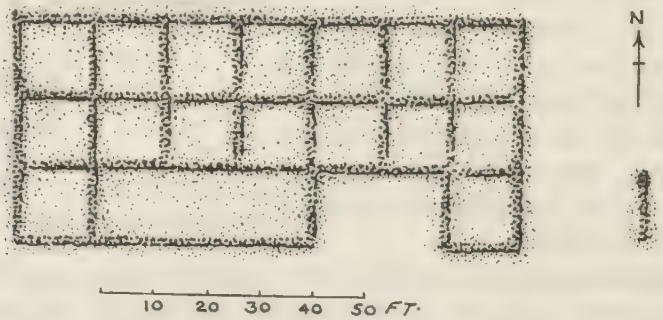


Figure 4.—Sketch of Individual Ruin

Two lenticular rubbish heaps lie on the open meadow 100 yards south of the walls of the large village. They are 60 by 72 feet and 4 feet high. Their presence at such a distance from the pueblo is

remarkable. Such mounds have been found in Chaco Canyon by Mr. Neil M. Judd and Dr. Frank H. H. Roberts, jr. West of the group a trench was made in débris of what appears to be a primary camp, occupied while the building of a clan house or a section of the village was being prosecuted. Another interesting feature of

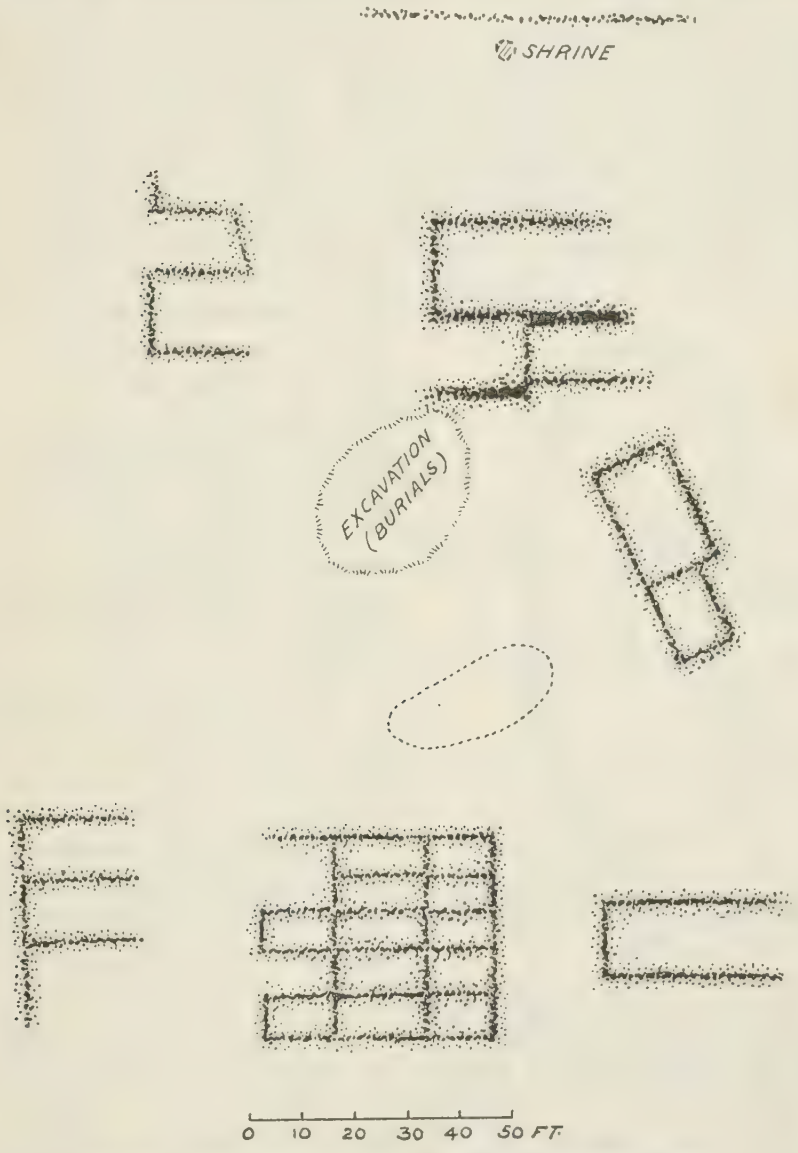


FIGURE 5.—SKETCH OF RUIN OUTLINES WEST OF GREAT PUEBLO

Pueblo engineering discovered here were retaining walls of several courses of quite large stone set on bedrock and apparently intended to counter lateral thrust of heavy masses of masonry (pl. 2, *a* and *b*). In the limited time allotted for the work many excavations were made by the Apache laborers, and several rooms cleared out with

good results as to artifacts and skeletal material. It is evident that these ruins would repay further examination, and since they represent the focussing of several cultures much could be learned as to distribution and time elements.

East of the spring and bounding that side of the valley are red bluffs covered with brush and timber. Along the bluff top are overgrown ruins that appear to be of ruder culture than those of the valley. On the level land beneath the bluff 1½ miles northeast of the spring is an oval pit 72 by 30 feet and at present 4 feet deep. At the side of the pit grows a checker bark juniper 132 inches in circumference. The débris of leaves, twigs, and fruit from the tree has filled the portion of the pit extending under its top spread. The surface drainage is away from the pit. The purpose of the pit is conjectural, but it was probably a ceremonial house connected with a ruin on the bluff near by (fig. 6). Considering the size of the slow growing juniper, this tree has stood on the side of the pit several hundred years.

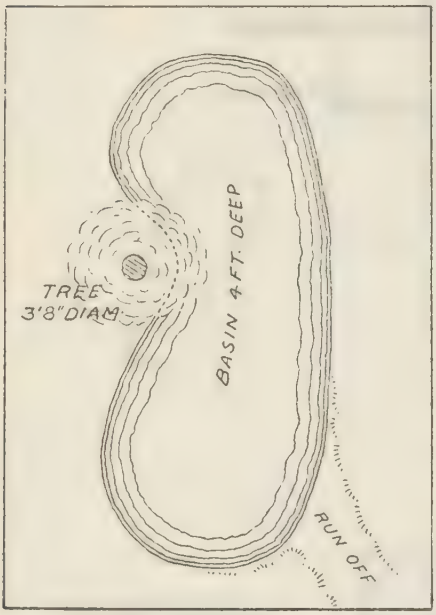


Figure 6.—Ceremonial Pit With Juniper Tree

Connection of this work with the rectangular stone walled kiva described by the writer in 1914 and the earth walled kiva of the Luna pit village is assumed. The kivas in the pueblos at Grasshopper were house room kivas, as shown by excavation in a room in which a decorated stone slab was found.

As is commonly observed in the surroundings of ruins, the immediate area is deforested due to activities in building and collection of fuel. The return of growths is an index of more or less importance in determining the age of a pueblo. At Grasshopper there has been a return around the margins of timber stands, but the meadow-like land around the pueblo appears sterilized to growths. One checker bark juniper 166 inches in circumference offers an interesting question. This tree stands near the border of the plaza west of the main ruin. The question is: Was this tree several hundred years old preserved by the Indians or has it grown since the decay of the pueblo? It is observed that this tree grows in the limestone outcrop and not in house débris, which probably accounts for its preservation.

Cliff dwelling.—During the exploration at Grasshopper a cliff dwelling in a lateral of Oak Creek, about 8 miles away, was examined. The ruin is picturesquely located under a great overhang of ribbed red sandstone conglomerate bedded with shale in a narrow canyon (pl. 3, figs. *a* and *b*). It is called by the Apache *Chidische*, red rock house, and sometimes *Tse a ke nastle*, house under the cliff.

The bow of the cliff back admitted in one place the building of three rooms deep and the adjoining structure two rooms deep. Along the front is a line of rooms now in ruins while the main three and two story building, probably the first erected, still stands. It is evident the front rooms represent later and poorer construction, as may be seen in the abutting of the walls against the face of the older building without bond (pl. 4, fig. *a*). There were three stages in the cliff dwelling, the dwellings in the deep bow in the rock face

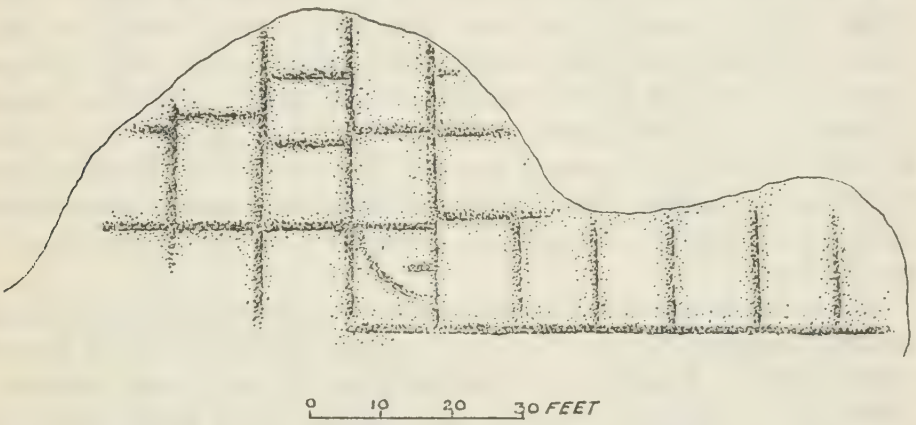


FIGURE 7.—PLAN OF CLIFF HOUSE, OAK CREEK

being the earlier. So far as now can be made out no change in culture accompanied the different periods of building.

The ground plan shows 24 rooms and the superposed rooms bring the count to 32, approximately (fig. 7). One room about the middle of the plan shows a curved wall of an older building (pl. 6*a*). Another room is built in a cavity on the ground plan and is like a basement. It has no débris on its floor of stone and is much blacked with smoke. It is entered by an opening in the room in the second story and by a hatchway from the room above.

Doors in this ruin are plain low openings not partially walled in below as in Mesa Verde (pls. 4*b* and 6*b*). The step is a larger stone much worn, and the lintel is three oak poles. One window in the upper room of the high house is in all intents like a door. The roofs and floors are of beams, poles, split cedar strips, and mud (pl. 5*a*). The beams are of juniper; one beam lying in the ruins of one of the

front rooms is 12 feet long and 8 inches in diameter, burnt and cut at the ends. A modern ax cut has subsequently been made near the middle. Some of the walls are still plastered, the mud laid on roughly bearing finger impressions.

The lower room in the high house has a ceiling of 8 poles on two beams. The filling between the poles is of rather regular lath riven from cedar laid in neat order. The upper room is entered by a hatchway two poles wide lined with flat stone laid up in several courses. This room is in two sections without partitions, the back room floor being slightly higher and covered with clay about 5 inches thick. Near the hatchway is an ovate fireplace of mud 15 inches in diameter and 24 inches over all. The grinding stones remain on the floor. This room is the largest in the cliff house, has no débris, and appears to be in the same condition as when it was occupied (pl. 5*b*).

A storage room on the ground floor still contains a mass of corn stalks. Other inside rooms have much débris that yields few artifacts of interest, the ruin having been searched by white visitors in the past and not by the Apache, who have a superstitious dread of such places. My Apache workmen, induced by duty and wages to visit the ruin, afterward purged their bodies of assumed evil influences by rubbing their arms and chests with sundry green herbs growing nearby. Needless to say, their work in the ruin was merely perfunctory.

The artifacts recovered from the cliff house débris differ little from material customarily found in such places. Slender cobs of 10-row corn, husks, and stalks were frequent; squash and gourd common; bows and arrows; fire sticks; cigarettes or pipes made from the pedicel of the corn ear; twisted branch ties; twilled basketry of yucca, not coiled; cloth, coarse and finer; cord, yellow and red wound on a slender rod; portion of a cord fringe skirt; and pieces of worked wood tablets comprise the list of such objects. The hafted stone blade, which is a unique specimen, shown on Plate 7, was found in this cliff dwelling by Mrs. B. A. Jaques of Lakeside, Ariz.

The hafting of this blade is accomplished by splitting a section of a wooden stem, placing the ends on either side of the stone blade, and securing the ends tightly with a wrapping of yucca fiber. In this way the blade is tightly clamped between the strips and so remain to this day. This simple method of hafting is rarely seen, and so far as known the specimen is unique in North America. Mr. H. W. Krieger has obtained this method in Santo Domingo. The finding of the hafted blade illuminates the use of the many thin basalt blades found on the Blue and San Francisco Rivers.[2]

[2] Bull. 87, U. S. Nat. Mus., 1914, pl. 4, fig. 1.

A ruin on a hill top 2½ miles northwest of Grasshopper pueblo is a major work and is interesting in the conformation to the area (fig. 8). This ruin appears to be older than the great ruin and

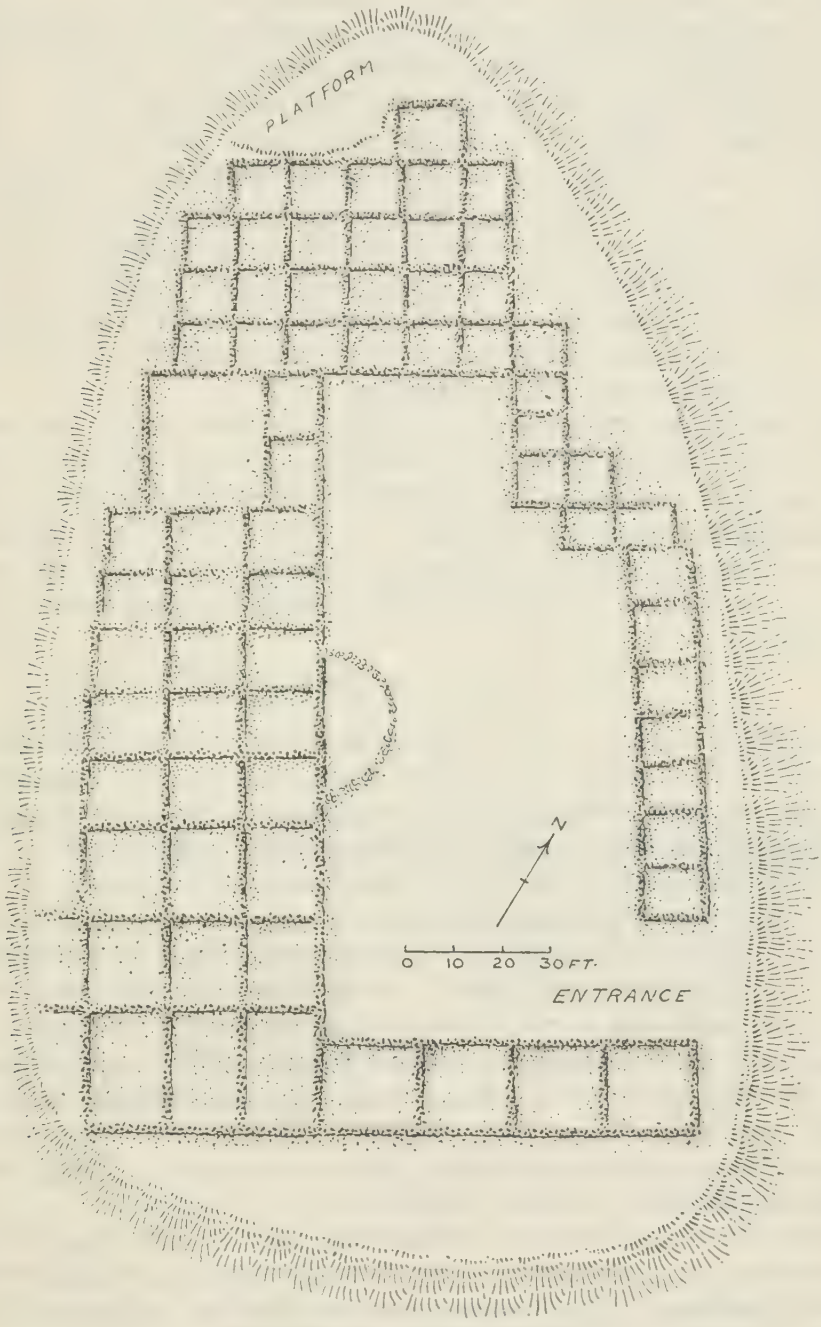


FIGURE 8.—PLAN OF HILL TOP RUIN

may have been abandoned during the gray and red ware period. There is plain evidence of long continued occupation in the great amount of débris covering the sides of the hill and in the different

phases of construction of the buildings. Large pines and oaks grow on the house ruins, showing that the forest has long reclaimed the site.

The plaza is 80 by 100 feet with an extension on the northwest end of 40 feet into the house mass at the northwest end. On the west side of the plaza is a high bank of house remains 60 feet wide with back along the edge of the hill. On the east side is a row of one story houses flanking the plaza and closing the east border of the hill. The entrance, 24 feet wide, is at the east point. Across the southeast end of the plaza are four unusually large rooms abutting against the west house mass. On the north, rooms begin to jut in on the plaza and coalesce with the houses covering the northwest end of the site. This collection of houses extends 100 feet to the northeast from the front break in the plaza and terminates in a platform of unknown purpose at the top of the hill.

A corral 21 by 24 feet is built against the west houses, probably by intruders. Among the west houses are several Apache graves. At present 60 rooms may be counted, and these are unusually large. Estimating the high western portion at three stories would augment the number considerably. Under the edge of the hill on the west side are traces of foundations of other houses overgrown with large junipers.

FIELD NOTES—GRASSHOPPER

Trenching was begun in the plaza, 80 by 120 feet, in the southern part of the great ruin and a section 30 feet long, 5 feet wide, and 6 feet deep was cut. The level plaza was recently made into a garden by the residents of the ranch who led a ditch in from the pond. The cultivated surface is strewn with flint flakes and fragments of pottery. The trench showed black packed soil for 2 feet and earth getting redder to the bottom. At 18 inches a band of charcoal of burnt corncobs, etc., was found; at 46 inches another band with ashes and reddened earth showing in a fireplace. No burials are encountered in the débris, but in the bottom tightly packed in the clay was the burial of a young person. No skull found, only arm bones, shoulder blades, and vertebrae. With these was a rude spheroid, corrugated vessel with broken rim and a disk from a rough vessel (fig. 9, section of trench).

A trench on the north side of the plaza near the buildings yielded three burials and no pottery. One of the burials was on a pavement of flat sandstone. The bones were too fragile for preservation. Further trenching brought to light many burials of adults and some pottery. Often burials of children in a bowl. Frequently no pottery with burials. Fireplace boxed in with slabs at the 36-inch level and much ashes.

The percentages of pottery fragments in the plaza were: red, 50; gray, 40; yellowish, 10; with corrugated omitted.

On the north side of the plaza 11 feet, of what is evidently a retaining wall, was uncovered. This wall, of heavy stones, is in four courses bedded on a red sandstone mass and on shale. This wall is 7 feet from the dwellings. It was built to hold this section of the pueblo at a point where in wet seasons the earth would have a tendency to slip. Several of these walls were unearthed. This feature is new in pueblo engineering (pl. 2, figs. *a* and *b*).

Began excavation of a room on the northwest corner of the plaza on the entry passage to the town. The room measures 11 feet by 11 feet, 8 inches, the north wall having 20 courses and the east 21. The north wall of very good masonry chinked with small tablets of stone. The door in the east wall is 28 inches square and there is a small opening in the south wall. Other walls inferior masonry (pl. 8, *a* and *b*).

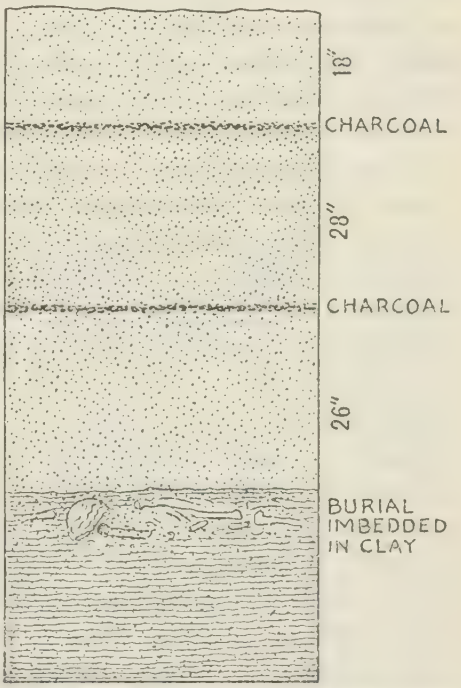


FIGURE 9.—SECTION OF PLAZA IN GREAT RUIN

Great number of flint flakes in the room débris, all suitable for cutting or scraping and many rechipped or otherwise worked.

A census of the artifacts from this room follows: 3 metates, 10 handstones, 20 hammers, polishing stones, iron and copper paint, flakes, flake knives, hoes, arrowheads, drills, disk, bone awls, picks, punches of antler, rings, cut bones, marked bones, animal bones, shell fragments, spindle whorls, spoons, worked pottery, handles, shards in order of frequency—1, red; 2, corrugated; 3, white; 4, various; charcoal, ashes (no beams).

Excavation on the east side of the passageway uncovered a fireplace with small rocks burnt black. Near this was a burial of an infant without offering. The child was very small, only the skull plates remaining.

Trenched on the south side of two low mounds 60 by 72 feet diameter and 4 feet high. These mounds are about 132 feet between centers and lie south 252 feet from the rear wall of the great pueblo west of the draw. Soil deepens toward the center about one inch to the foot. Soft, loose débris, with charcoal, ashes, flint chips,

shards, etc., but no burials in the 14-foot square area excavated. These mounds are evidently places of deposit of house refuse, nearly one-tenth of an acre being covered with a lens of débris 45 inches deep in middle and nearly a hundred yards from the pueblo.

Pottery percentages: Gray, 12; rough brown, 29; red, white line, 48; gila type, 8; and yellow shades, 2.

Near the center of one of the mounds is a fire seam with ashes and burnt rocks 20 inches from the surface and 20 inches from base. The center area seems to go down deep. Possibly excavation here would show a pit basin like those in Luna, N. Mex., and at Interior Sawmill (pl. 10*a*) on this reservation; mound has been worked over by ground animals.

Surface of runnels east of the great pueblo contains many shards washed out over the flat. Made a hole 11 feet square and 2 to 4 feet deep in house debris east of entrance to pueblo on east side but found no burials. Approached the walls of the presumptive watch room at entrance of main pueblo. Soil not good.

Opened large trench in the gently sloping area extending 250 feet north of great pueblo and found one or two burials, and animal bones in débris from 30 to 40 inches deep to hardpan.

Surface ruins to west of main pueblo show as rectangles of limestone imbedded in the ground. In the house débris several burials, both near the surface and on hardpan, recumbent and flexed. Skulls except one show occipital deformation. Pottery shards vary from crude to fine. Red with black outlined with white; white; white surfaced, green decoration in glaze; black and white; red brown "pebbled" surfaced with white line decoration with polished black interior. Fragments of axes, arrow polishers, awls, drilled antler sections, arrowheads, etc. Soil 30 to 45 inches thick.

Trenched along walls of outlined or "unfinished" houses on flat area west of pueblo. Found that walls are laid on older house refuse deposits. Four courses of masonry were seen. There is no evidence of character of superstructure. Trench east of a pueblo lying north of the large group shows little decorated pottery, but brown with black polished interior prevails. Perhaps residuum of an older clan. Earth 40 inches deep, 15 feet from wall. Retaining walls found in this trench.

Percentage of shard types from trench 16, west side of east pueblo: Red, 33; gray, 18; brown, 11; rugose, 26; yellow brown, 2; Gila, 4; and yellow, 4. Most of the shards in the upper foot.

Trenched a lens of house refuse 200 yards west of the large pueblo showing as a slight elevation found to be 1 foot thick. Contains a fair amount of shards, not much flint, a few worked bones, and very few animal bones. The shards show thick coat of lime deposit. This site appears to be a temporary camp occupied while the pueblo was

being built. Shard percentages are: Gray, 20; red, 10; polished brown, 20; rugose, thick, 50.

Opened up a room in northeast corner of great plaza. Not many shards; soil pretty clean and in parts curiously stratified as though deposited in water. Many well-squared building stones in the soil. West wall crudely laid up. Large fragments of red ware and much ashes on floor. Indications that the building was 4 or 5 stories at the point. Percentages of pottery: Red, 70; gray, 17; Gila, 4; brown, 9; with much rugose ware.

Opened up a long wall of a large room in a high part of the west pueblo. Masonry very good, stone faces seamed and cracked, one stone with scorings. (See pl. 8.) This room probably ceremonial. Another near-by room has a screen of loose stones added for partition. In the room nine beaming tools of deer pelvis, many jaws and other bones of deer, two large axes, and a painted circular stone tablet were found. Pottery, red predominating. In the room were two fireplaces, one boxed with slabs.

ARTIFACTS

Stone.—Stone artifacts are not plentiful at Grasshopper as the ruin has for a number of years been near a trading post and the Indians have gleaned the surface. The Apache still make bows, arrows, and quivers, these salable articles bringing in some monetary return. For this purpose arrowheads and flint flakes are picked up sedulously and worked over to point the arrow shafts. On several occasions the writer has watched Indians chip arrowheads, the chipping now being performed with a knife blade.

The débris here is sown with smooth gray chips of flint derived from outcrops of beds in the limestone and excellent material for the aboriginal lapidary. Arrowheads found are slender and well made or gross and poorly made. The slender points are of the swallowtail type. Rarely are nocks observed, indicating that the points were set on the shafts with gum, a common practice still with the Apache and of other tribes who lived in the region. Knives of medium size; ovate, flat, thin scrapers; drills, some long and finely chipped; and some with spatulate finger grip, differ in slight degree from those generally found in Pueblo sites. Pillow-shape rubbing stones, metates, and manos are relatively frequent. Smoothing stones or pottery polishers are found. One smoothing stone of jade green translucent steatite, a material occurring in Oak Creek canyon, was taken from an excavation. Grooved arrowshaft smoothing stones are in the material found. Axes are of two sizes: A large wedge shape with single interrupted groove 9¾ inches long, 2¼ inches thick, 3 inches wide (24.5 cm. long and 9 cm. wide), weight 5 pounds,

and small more flattened specimens grooved in a similar way. A small and a large bilobed chipped ax were recovered. Hoes are represented by a spall of limestone, chipped and broad in front and tapering toward the back.

Pipes.—Short tubular pipes of soft stone were made at Grasshopper. The simpler form is a truncated cone of polished black steatite. A larger has the exterior of the bowl roughened as though to imitate a corncob. A third, of polished black stone, has a small projection at one side by which the pipe was held. A specimen found in a cave on Oak Creek is of the fine-mottled sea-green steatite mentioned. This pipe, the property of Mrs. B. A. Jaques, was taken from this cave, where it had likely been offered. The Apache Indian who found it fled because he "heard voices." It is of the uncommon type of the small pipe (pl. 9, figs. *a–d*). The projection slants upward. The workmanship of this pipe is excellent.

A circular slab of sandstone having a projection and with traces of a painted design and circular hole 2 inches in diameter in the middle was found in a room south of the entrance passageway to the main ruin. With it was found a large ax and a gray water vase. This stone appears to be ceremonial, representing the sipapu or entrance to the spiritual underworld. Several stones of this character have been found in ancient pueblos.

Masses of red-paint stone were taken from excavations in rooms.

The rarity of beads in this ruin is remarked. A few large beads of black steatite occur and fragments of shell armlets were taken from the débris. A few olivella shells were seen, also small carvings of black steatite probably intended for necklace ornaments.

There was no lack of bones of animals in the débris at Grasshopper, showing that there was abundance of game here at the time of occupation, principally deer, and a fair amount of bird bones, mostly turkey. Worked bones are numerous and consist of long bones from which sections have been cut, rings, tubes, awls, antler tips. There is little engraving of parallel lines on awls. Nine deer-pelvis scrapers were found together in a room. The bone art differs little from that figured in other reports and no new types are noted.

Gray ware.—Typical gray or black and white ware referable to the San Juan pottery of Kidder penetrated only sporadically below the escarpment from which spring the Salt and Gila Rivers, usually on the upper reaches of these streams. Of these sites Forestdale is predominantly a gray site as is Blue, though in less degree. At Grasshopper gray is in appreciable amount, the excavation count giving 22 per cent. Whole specimens in burials are very few.

Black-on-white ware, together with the same type in red, occur in some amount at Grasshopper as the shard percentages in the excava-

tion pits show. As stated, no stratification evidence was found to show that the ware was older than other types in the ruins. The presumption is that the black on white came into the Grasshopper complex as a remnant of the original wave from the San Juan and was perpetuated by some surviving clan. The occurrence of the black on white in localities far from the original seat forms an interesting problem of distribution which must seriously be taken up by the student. In general, the ware from its material and the persistence of its designs affords a good basis for the study. It may be remarked that the highest class of this ware has a pure kaolin paste not requiring surface treatment with white. This class, on account of geological environment as to clay, is rare in most parts of the region. Where impure kaolinic clays occur without ochers and burn to a dark gray, a wash of white was used and infrequently red. Where black on white was to be produced with common clay with ochers in their composition, a wash of white clay was needed. In this way ware equivalent to the type black and white could be made for customary tribal usage in any part of the Southwest. It is evident that migrants from the black-on-white centers pursued this course because of the persistence of the designs on inferior paste found in various parts of the terrane. Black-on-white ware is particularly interesting in marking out the earliest migrations in the Pueblo region.

The geological environment is also responsible for the first ware made in the Pueblo region, as shown by the collection of Doctor Roberts from a late Basket Maker[3] in Chaco Canyon. This ware is evidently the initial effort in the black on white series in which the ground is generally undecorated as in a normal first stage in ceramic technology.

The forms of the ware at Grasshopper are large, flat-globose water vessels, bowls with straight rims, and small pieces of various forms. In general the designs show solid with hatched drawings characteristic of the ware, but there are often modifications to be expected from the distance from the source and local conditions. In this respect there may be mentioned the conventional treatments of plumage as squares with a spot in the middle or trapezoids with the spot, the hourglass shape bird forms, and the inclusion of an eye in the solid black design indicating an animal. In these instances the design is less pure than that of northern specimens or even of Forestdale and the upper Tularosa. An interesting specimen of water jar, 14 inches (36 cm.) in diameter and 10 inches (25.5 cm.) high, was recovered in fragmentary condition. The paste is homogeneous gray but has been slipped. The decoration is in geometric

[3] Bull. 92, Bur. Amer. Ethnol., 1929, pp. 108, 109.

bird design, plumage feathers represented by diamonds with dots in the center, pinions by parallel lines. The head is a long wedge with a white dotted eye.

Gila ware.—Gila ware is characterized by soft paste of red brown colors slipped with cream white over portions of the area and decorated in black. Peculiar also to Gila ware is the incorporation of undecorated areas in the patterns and the use of bright red pigment producing polychrome effects. The designs are never outlined with the white or color.

In typical Gila ware centered in the upper valley there is never any exterior rim decoration on bowls. Variation from the type in locations where Gila ware has spread sometimes show rim patterns. One such specimen was found at Grasshopper. The interior decoration of bowls is based on 4 arranged in a band, leaving a quadrangular area in the bottom. A characteristic is the incorporation in the design of large circular areas in white with a black spot in the center. Symbolic elements diffused through Pueblo art are utilized, but in a less informed fashion. Technically also less skill in drawing and composition are evidenced or conversely we have a style in which these elements are consonant. Nature and life design elements are used principally in combination, very rarely as separate entities. It may be said also that this characterized a rather primitive stage of art and it may be possible to place the Gila art at an earlier period than that of the Little Colorado valley, a supposition I would favor. Further, the affiliation of Gila ceramics is with that of some of the Rio Grande pueblos, specifically, Santo Domingo, Santa Clara, Tesuque, and other Tewa pueblos where partial application of thick slip and black decoration is common technique. A portion of Zuni ware shows the influence of Gila technique.

Forms of Gila ware are limited, bowls usually, some vases and large ollas, and occasionally figurines. The bowls are almost always incurved and the exterior unpolished.

At Grasshopper Gila ware removed whole or mendable comprised 3 bowls and 12 large fragments. Its occurrence in the pits was 8 per cent.

Chevlon ware.—This is so named from the type locality near Winslow Ariz., worked by Dr. J. Walter Fewkes and the writer in 1897, is strictly in the red ware class. It belongs to the variety having a red wash on a black and white ware paste base. This variety is the first color variant observed in the San Juan region and accompanying the black and white in such sites. This red appears to be the first of its kind and is contemporaneous with the black and white. Very early in the pottery art among the Pueblos it was found necessary to wash or slip the surface of ware where paste lacked ocher, therefore burning dark gray. Few kaolinic clays burning

white were to be had and the Pueblo potters hit upon the wash of pure kaolin to produce the effect. Similarly they discovered the red wash of iron ocher. Numerous tribes the world over had not advanced to this phase of the art. Partial slipping is seen in Rio Grande pottery and some Zuni varieties. Absence of slip is seen in Mohave, some Pima, Diegueno and other southern California tribes, and most of the remaining United States. In the ceramic art in general the use of slip has no especial classificatory value, but only bears on the progress in the art. The use of slip also indicates the need of a uniform background on ware intended to be decorated as well as the desire for a uniform color.

Chevlon ware possesses as strongly marked characteristics as any other Pueblo pottery, and for this reason its occurrence in other sites is a valuable clew to distribution. This ware may be expected to occur in varying percentage in sites on or south of the Little Colorado River, larger in sites from 35 miles south of the river to the north front of the White and Mogollon ranges. Thus we find at Chavez Pass and Pinedale much Chevlon ware associated with yellow and red brown also at Four Mile and other sites in the Taylor region. Here and there in sites east of Winslow to the Petrified Forest pieces occur. Apparently none of the type is represented in ancient Zuni ware. Homolobi, a short distance from Chevlon on the north bank of the Little Colorado, shows a very small percentage. Homolobi has yielded a great quantity of transitional Hopi ceramics and it is probable that this ruin and Chevlon were not contemporaneous. The distribution of Chevlon ware south of the great natural geographical obstacle of mountain and escarpment is quite limited, more specimens being found at Grasshopper than in any other sites examined below the " Rim."

The principal forms of Chevlon ware are bowls, pots, and vases, marked as mentioned with strong tribal characteristics of art. Bowls are incurved with ample rounded sides and well proportioned in the ratio of height to diameter. Pots are spherical with outcurving or straight rims. Vases are in general turnip shape with straight collar.

The decoration of Chevlon ware was laid on with a dense lustrous black and kaolin. It is evident also that the ware was subjected to hard firing. In the decoration the black preponderates and is outlined and otherwise set off by the kaolin, giving a striking contrast. Sometimes the black is appliquéd in small dots on the kaolin.

The decorative designs of Chevlon ware have not reached the stage of geometrization observed in most Pueblo wares. The patterns lie between the conventional and realistic. The fundamental base of four is generally not as an axis for the arrangement of designs.

This sets apart Chevlon ware and suggests a modernization and freeing of decorative art as observed at Acoma though not to the same extent. In Acoma decoration few of the customary Pueblo symbols are recognizable; in the Chevlon ware many of the symbols are present though handled in the free manner observed in the Little Colorado region. Especial interest is centered on the volute prominent in Chevlon design. This figure first appears prominently in the pure gray ware period and so far as known is one of the earliest motives in Pueblo ceramic decoration.

As a bird symbolic convention, it is the most widespread of all Pueblo design. It was freely incorporated in geometric and curvilinear bands or edgings. In areal treatment it formed the central key to the bird figure representing the head. Chevlon ware employs the large whorl as a separate unit design while the northern white on black ware whorl is a continuous line repeat or rarely a disconnected spiral.

In the use of a free field, for example in bowls, the Chevlon potters achieved remarkable artistic results. The bold exotic decoration is striking. The fortifying of the design at appropriate places with white is done in a masterly manner. Exterior rim decorations of the ware are usually linear, white lines being decorated with applied black dots.

Some realistic figures occur rather frequently in Chevlon red ware. Specimens found at Homolobi and Four Mile by Dr. J. W. Fewkes and the writer show a remarkable conception and execution of these figures.[4] A specimen of unmistakable importance not figured from Chevlon shows two serpents with geometric patterns on the body suggestive of the Mimbres, arranged as on the Mexican calendar stone.

Red ware.—At Grasshopper ruin, red ware is comparatively common among the potsherds in the débris. Complete specimens recovered are deep bowls of soft paste, intense red in color, no ornamentation on the exterior, and with decoration in black on the interior. On account of the fragile paste this pottery is not often recovered in excavations, and for this reason its prevalence in some southern ruins is lost sight of. The collections of pot hunters who save only entire specimens, in most cases, do not represent the types found in certain ruins. Personal observation on the Delgar ruin on the Tularosa, classed by recovered artifacts as a typical gray ware site, led the writer to the conclusion that soft red ware existed in equal amounts with the gray. The ware was encountered by the untrained excavators, but was found in nearly all cases to be in small pieces and was not collected. A census of the shards turned up in the excavations, not from the surface, has been pursued by the writer

[4] 22d Ann. Rep., Bur. Amer. Ethnol., pt. 1, 1904, pls. 24, 25.

for many years as the best method of ascertaining the ceramic index of an ancient ruin. The association of the red with the gray is normal, as on the San Juan, but there is reason to believe that in the Concho region there exist sites in which soft red only occurs with coiled ware.

The designs in the interior of soft red bowls follow the San Juan tradition and show none of the divergences of design characteristic of the region south of the little Colorado. This is evidence of an older stratum of design.

A rare type of brown ware with unusual surface decoration is found very sparingly at Grasshopper. Its position among ancient Pueblo ceramics is at present uncertain. The decoration noted on a red-brown bowl with polished black interior and slightly rugose exterior is in chevrons bordered by white lines and tinted in soft chocolate brown color. The effect is highly artistic. The affiliation of this ware appears to be with the decoration-on-coil ware found mostly in the high mountain ruins as at Linden, Arizona, and sometimes in ruins in the Little Colorado valley as at Four Mile and the Petrified Forest. It is interesting in showing the application of basket patterns to coiled ware in pigment instead of indented or scratched patterns on the coil. It is observed that in the period of elaboration of ceramic art in the area south of the Little Colorado pieces of noteworthy excellence were produced that place themselves outside the classes of ceramics influenced by conventional tribal standards of art. As a suggestion the ware described may come under this head.

A specimen, evidently sporadic, consists of a bottle form of thin brown undecorated ware, and was found at Grasshopper. The specimen relates itself to the ware characterizing a wide belt from southern California eastward to the Pima. This specimen would seem anomalous at Grasshopper were it not from the circumstance that the writer observed two sites north of the Sierra Anchas covered with surface fragments of plain thin brown. Mr. Earl Morris is authority for the statement that a number of other sites of this character are found in this region. The group responsible for the ware is conjectural, but if decorated specimens are recoverable, as seems likely, this point may be cleared up.

Coiled ware.—At Grasshopper this is in most instances rude in form and technique. In a site yielding so many types of pottery, none apparently indigenous, this is to be expected. There is no clear cut coiling, the ridges and indentations being partially smoothed, a feature common in mountain ruins. Some specimens of very delicate coiling were found, but these probably came from some other workshop.

In the ruin there is a complete absence of the brown ware with polished black interior so common at Blue and entering prominently

in the ceramics of sites north of the mountains as at Four Mile and Eldon Pueblo.

Varicolored wares are well represented by fragments at Grasshopper. No specimens found with burials would indicate that the shards are relics of the latest occupants of the pueblo. Also the distribution of the shards is greatest to the east of the main ruin in a swale scoured by surplus water. The colors are brown, red brown, deep buff, and cream with varying designs. Polychrome ware is on buff, the black designs having red additions. One fragment of a bowl of light color paste has red exterior and black line decoration outlined with white. The interior is buff with black hachure and red lines are the background. One specimen is decorated with red mat and greenish lead glaze. A few shards of this class were seen.

NOTES ON APACHE INDIANS

The present inhabitants of this region, occupying it long after the pueblos were abandoned, are the White Mountain Apaches. These Indians show little white mixture, but the present group is a medley of remnants of other Apache tribes that have not survived the violent contacts of a former period.

The population in 1919 showed an increase from 1918 of 8. The population in 1929 was 2,648 and the decrease from 1928 was 8. Unless the benefits of modern healing and sanitation which have been introduced by the Indian Office are successful, the White Mountain Apache are doomed to extinction. The Apache generally are quite conservative and have been slow to take advantage of the betterments offered them. On the material side, however, the Apache have made great strides, adopting banking, costume, wagons, harness, canned goods, and many other things from the white man.

In housing, so far they maintain the earth floor, dome-shape lodge whose structure is hidden by the masses of bear grass that cover it (pl. 10, fig. *b*). Its affinity with the Navaho hogan is seen in the vestibule. These houses are dark and unsanitary. Whenever there are several houses forming a diffused cluster, open air arbors or *ramadas* of southern origin appear (pl. 10, fig. *c*). These are assembly places and furnish a grateful shade where various work may be carried on. For a number of years the Apache have been encouraged to build houses of modern style, but probably on account of the objection of the women there have been no results.

The White Mountain Apache rank high in intelligence, take kindly to education, are alert in business, and are first-class workers. Hundreds of miles of good roads have replaced the trails over the reservation and these were built by the Apache.

a

b

c

WHITE MOUNTAIN APACHE INDIAN RESERVATION

FOR EXPLANATION OF PLATE SEE PAGES 3, 4.

a

b

WHITE MOUNTAIN APACHE INDIAN RESERVATION

FOR EXPLANATION OF PLATE SEE PAGES 5, 11.

a

b

WHITE MOUNTAIN APACHE INDIAN RESERVATION

FOR EXPLANATION OF PLATE SEE PAGE 7.

a

b

WHITE MOUNTAIN APACHE INDIAN RESERVATION

FOR EXPLANATION OF PLATE SEE PAGE 7.

a

b

WHITE MOUNTAIN APACHE INDIAN RESERVATION

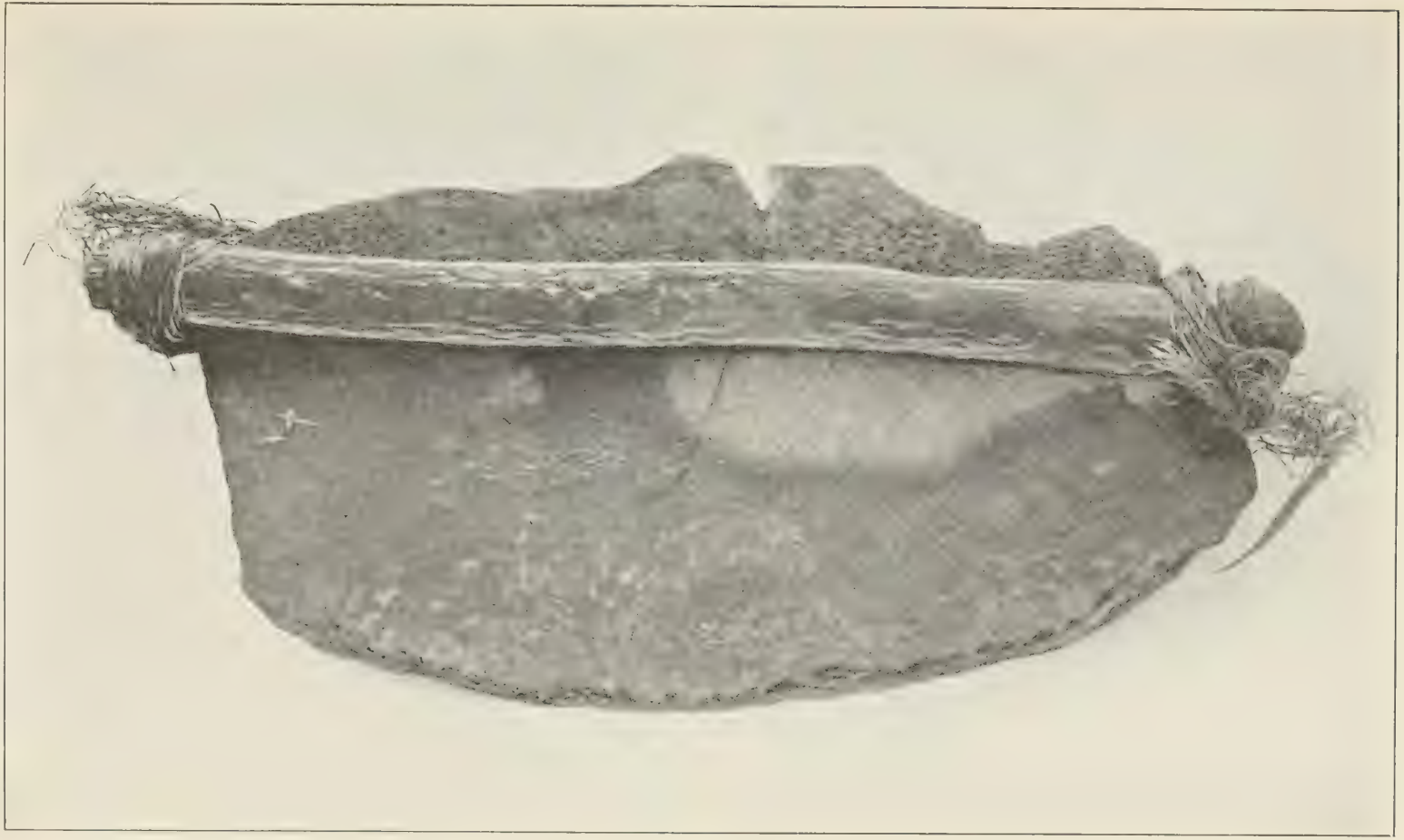
FOR EXPLANATION OF PLATE SEE PAGES 7, 8.

a

b

WHITE MOUNTAIN APACHE INDIAN RESERVATION

FOR EXPLANATION OF PLATE SEE PAGE 7.



HAFTED STONE BLADE FROM THE CLIFF HOUSE, WHITE MOUNTAIN APACHE INDIAN RESERVATION

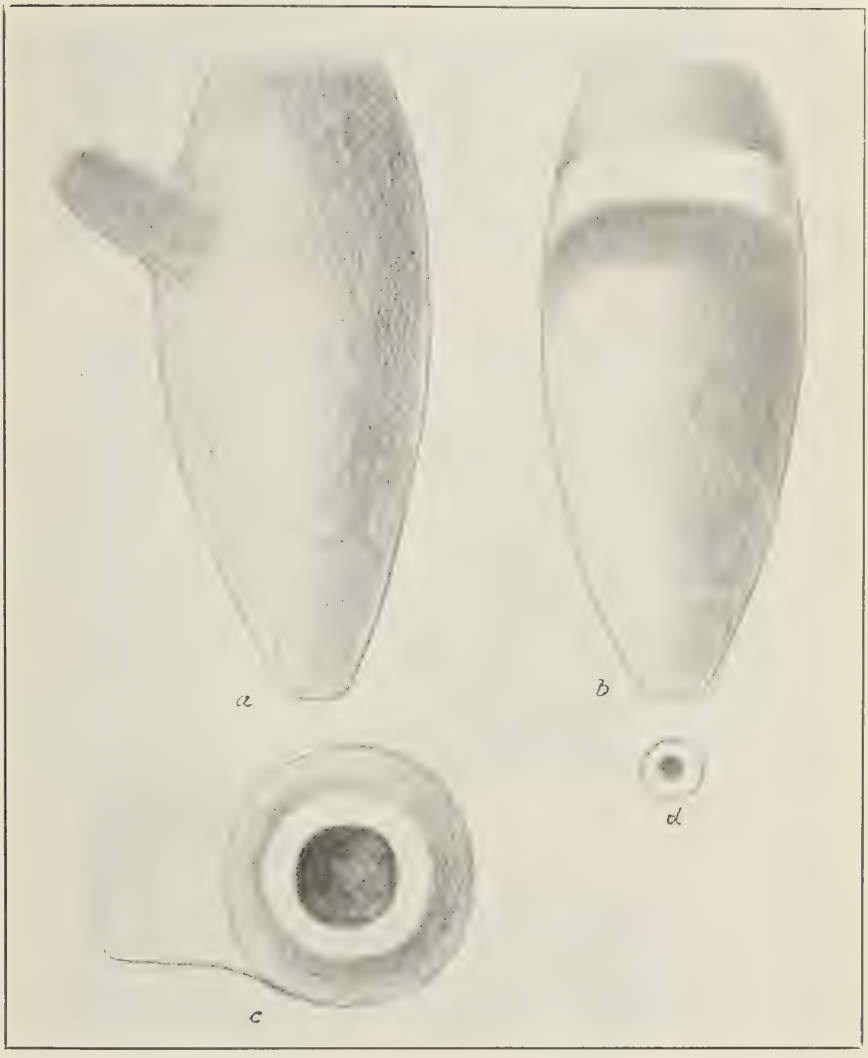
FOR EXPLANATION OF PLATE SEE PAGE 8.

a

b

WHITE MOUNTAIN APACHE INDIAN RESERVATION

FOR EXPLANATION OF PLATE SEE PAGES 11, 13.



SOAPSTONE PIPE FROM WHITE MOUNTAIN APACHE INDIAN RESERVATION

FOR EXPLANATION OF PLATE SEE PAGE 14.

a

b

c

WHITE MOUNTAIN APACHE INDIAN RESERVATION

FOR EXPLANATION OF PLATE SEE PAGE 20.

EXPLANATION OF PLATES

PLATE 1

White Mountain Apache Indian Reservation

a, Surface ruins. *b*, View of great ruin. *c*, Nearer view showing walls.

PLATE 2

White Mountain Apache Indian Reservation

a, Retaining wall to support house mass. *b*, Retaining wall to prevent earth slipping.

PLATE 3

White Mountain Apache Indian Reservation

a, View of canyon above cliff house. *b*, View of cliff house across canyon.

PLATE 4

White Mountain Apache Indian Reservation

a, Chinked wall and doorway; abutting wall of later building (left). *b*, Doorway at ground level with steps.

PLATE 5

White Mountain Apache Indian Reservation

a, Fragment of a mud partition strengthened with cedar splints. *b*, Upper room showing fire place, mealing stones, and plastered walls. Cliff house.

PLATE 6

White Mountain Apache Indian Reservation

a, Interior room of cliff house with bowed wall. *b*, Doorway in masonry wall of a room.

PLATE 7

White Mountain Apache Indian Reservation

Hafted stone blade. Cliff house.

PLATE 8

White Mountain Apache Indian Reservation

a, Superior masonry of room in first ward of great pueblo. *b*, Later crude masonry in room partition.

PLATE 9

White Mountain Apache Indian Reservation

Soapstone pipe from Oak Creek Cave. *a*, Profile. *b*, Front view and mouth orifice. *c*, View from above. *d*, Mouth opening.

PLATE 10

White Mountain Apache Indian Reservation

a, Square pit kiva. Interior Sawmill. Apache Reservation. *b*, Apache house. Oak Creek. *c*, Apaches under a ramada or arbor. Oak Creek.

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NOTES ON ICHNEUMON-FLIES OF THE GENUS POLYCYRTUS WITH DESCRIPTIONS OF NEW SPECIES

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The genus *Polycyrtus* Spinola appears to be confined to the American Tropics, with the exception of one species occurring in the southeastern part of the United States and as far north as Connecticut. With more extensive collections in southern Florida and Texas some of the West Indian and Central American species may be found to occur in those localities.

As in many tropical genera there appears to be a great number of species but individuals of most of the species appear to be not at all abundant. Of the more than 70 species from the tropics in the material that I have examined only 6 are represented by more than 2 specimens and only 2 by more than 4, while 57 are represented by single specimens. A very large majority of these species are certainly undescribed.

Of the species here described 36 are new, while 25, represented by unsatisfactory material, will remain undescribed.

I have already[1] synonymized *Polycyrtimorpha* Viereck with *Polycyrtus*. *Cryptanuridimorpha* Viereck and *Cryptopterigimorpha* Viereck, originally distinguished from each other by the very variable position of the second recurrent vein with respect to the second intercubitus, are synonymous, and, under the former name, constitute a subgenus of *Polycyrtus* in the present treatment. The only respect in which this group differs from typical *Polycyrtus* is in the very great development of the hypostomal carinae. In the typical subgenus there is great variation in the height of these carinae, but they are always erect, never bending toward each other to form a cavity over the base of the maxillae as they do in *Cryptanuridimorpha*. The addition of several other species to *Cryptanuridimorpha* shows that in that subgenus as well there is marked variation in the height of these carinae and consequently in the length of their line of meeting.

[1] Proc. U. S. Nat. Mus., vol. 74, art. 16, 1927, p. 50.

My description of the genus in the reference cited above needs slight correction as follows: The humeral margins of the pronotum, though usually tumid, are not always strongly swollen nor are the epomiae always evident; in many species, especially those of the subgenus *Cryptanuridimorpha*, the depression of the notauli extends somewhat beyond the margin of the pronotum; in a few species, in which the propodeal apophyses are in the form of high carinae, the apical carina is complete.

Because of the small numbers of specimens of nearly all of the species and the consequent lack of knowledge of the extent of variation, I have thought it best to give rather full and detailed descriptions. Undoubtedly many of the characters described will be found to vary considerably. I have little confidence, for example, in the constancy of such characters as the position of the second recurrent vein in relation to the second intercubitus or of the nervulus with respect to the basal vein, the position of the fracture of postnervulus and nervellus, the details of the structure of the frons immediately above the horn, the sculpture of the metapleurum and to some extent of the propodeum, and the relative length and breadth of the tergites, as well as in certain details of color, though certain other details and color pattern in general are surely of specific significance.

Apparently nothing is known of the host relations of the species.

The following key includes only those species that I have examined. At the end of the paper, however, I give a key which includes all the described species that appear to be referable to the genus.

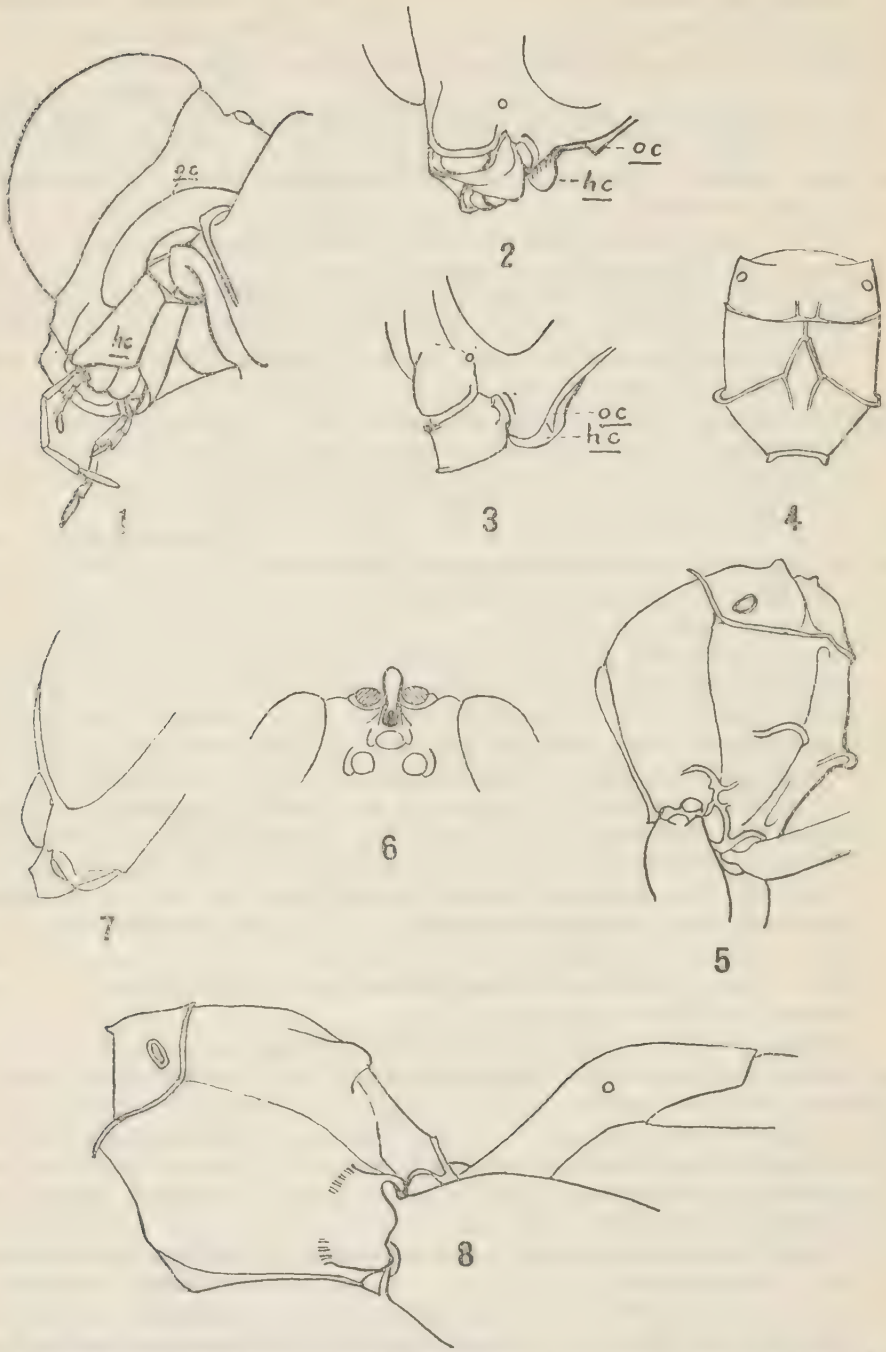
Genus POLYCYRTUS Spinola

(For references see under subgeneric heading)

KEY TO SPECIES EXAMINED

1. Hypostomal carinae very high, arching over the bases of the maxillae and labrum and meeting or nearly meeting on the median line (subgenus *Cryptanuridimorpha* Viereck) (fig. 1)----2.
   Hypostomal carinae frequently very high, but never arching over and covering the bases of the maxillae and labium (subgenus *Polycyrtus* Spinola) (figs. 2, 3)----7.
2. Abdomen beyond first tergite black, lateral margins of tergites usually white----3.
   Abdomen red----6.
3. Hind legs with femur, tibia, and basitarsus black; tergites not white laterally----1. elegans (Viereck).
   Hind legs with femur at most piceous, tibia yellowish and tarsus whitish; tergites laterally white----4.
4. Space between hypostomal carina and cheek not so deep, the margin hardly carinate; hind femur ferruginous----5.
   Space between hypostomal carina and cheek very deep and separated from cheek by a sharp carinate margin; hind femur piceous.
   4. inca, new species.

5. Frontal horn black----2. **capitator** (Fabricius).
Frontal horn white----3. **albiniclavus**, new species.
6. Head, pronotum, and mesoscutum black, without white markings.
5. **tubulifera** (Viereck).
Head with face, clypeus, frontal orbits, and apex of horn white; entire thorax red----6. **buscki**, new species.
7. Apical carina of propodeum wanting, apophyses long or tuberculiform, rarely carinate----8.
Apical carina complete, angled sharply forward in middle, apophyses in the form of high carinate elevations (fig. 4)----48.
8. Apophyses of normal form; mesoscutum without tubercles above tegulae--9.
Apophyses in the form of high transverse carinae (fig. 5), the propodeum longitudinally sulcate from basal carina to apex; mesocutum with a white tubercle above each tegula----48. **carinispinis**, new species.
9. Propodeum and metapleurum not rugose, or if so apophyses are long; frontal horn usually spiniform or conical, rarely constricted near base--10.
Propodeum and metapleurum coarsely rugose, apophyses low rounded tubercles; frontal horn bulbous (fig. 6); areolet very small.
47. **bulbosus**, new species.
10. Nervellus broken, discoidella distinct; areolet much longer than broad with recurrent at or near apex; mesoscutum immaculate or with two white lines on disk----11.
Nervellus unbroken, discoidella entirely wanting; areolet nearly as broad as long, with recurrent not far beyond middle; mesoscutum with a median white spot----46. **infractus**, new species.
11. Clypeus more or less distinctly inflexed; scutellum high and more or less compressed; apophyses usually elongate, in male sometimes low but not so smoothly rounded; first segment at most weakly decurved----12.
Clypeus and scutellum strongly convex but clypeus (fig. 7) not inflexed at apex and scutellum not compressed from sides; apophyses low rounded tubercles; first abdominal segment strongly decurved (fig. 8); ovipositor more than half as long as abdomen----45. **rufipleuris** Szepligeti.
12. Thorax entirely ferruginous----13.
Thorax more or less black, at least mesoscutum black or piceous----25.
13. Abdomen entirely ferruginous----14.
Abdomen black and white, at most with first tergite largely red----18.
14. Inner and superior orbits broadly white----7. **ornatifrons**, new species.
Orbits not at all white----15.
15. Head entirely black----8. **inornatus**, new species.
Head with a least clypeus pale or reddish----16.
16. Clypeus and mandibles reddish----9. **minutus**, new species.
Clypeus and mandibles white----17.
17. Occipital carina very prominent below and separated from hypostomal carina by a deep groove----10. **boliviensis**, new species.
Occipital carina fading out some distance from hypostomal carina but not prominent at lower end, the space between it and hypostomal carina shallow----11. **areolatus**, new species.
18. Occipital carina abruptly interrupted below, its lower end very prominent and separated from hypostomal carina by a deep, broad furrow----19.
Occipital carina reaching hypostomal carina or if not its lower end is not prominent or there is only a small notch next to the hypostomal carina----22.
19. Face black----20.
Face white----21.



1, Polycyrtus (Cryptanuridimorpha) albiniclavus Cushman. Oblique view of back of head to show hypostomal carinae (hc); oc=occipital carina. Drawn from type; 2, Polycyrtus (Polycyrtus) proximannulatus Cushman. Lower part of head to show hypostomal carina (hc) and occipital carina (oc). Drawn from type; 3, Polycyrtus (Polycyrtus) lituratus Brullé. Lower part of head to show hypostomal carina (hc) and occipital carina (oc); 4, Polycyrtus (Polycyrtus) humerosus Cushman. Propodeum. Drawn from paratype; 5, Polycyrtus (Polycyrtus) carinispinis Cushman. Propodeum. Drawn from type; 6, Polycyrtus (Polycyrtus) bulbosus Cushman. Top of head to show frontal horn. Drawn from type; 7, Polycyrtus (Polycyrtus) rufipleuris Szepligeti. Side view of clypeus; 8, Same. Propodeum and first segment of abdomen

20. Clypeus black----12. **nigriclypeatus**, new species.
Clypeus white----13. **impressus**, new species.
21. Head in profile with occipital carina nearly parallel with posterior margin of eye; metapleurum rugose----14. **prominens**, new species.
Head in profile with occipital carina distinctly convergent above with eye margin; metapleurum sparsely punctate----15. **convergens**, new species.
22. Face laterally and frontal orbits white----16. **isthmus**, new species.
Face and orbits black----23.
23. Occipital carina prominent below, reaching hypostomal carina but with a small notch next to hypostomal carina----24.
Occipital carnia not at all prominent below but fading out a short distance from hypostomal carina----19. **brevigenalis**, new species.
24. Clypeus black, piceous in middle; frontal horn and apophyses very small. 17. **parviclavus**, new species.
Clypeus white; frontal horn and apophyses not reduced. 18. **paranensis**, new species.
25. Abdomen entirely ferruginous----26.
Abdomen black and white, sometimes with petiole ferruginous and rarely with margins of tergites reddish----27.
26. Mandibles black; frontal horn white at apex; parapsidal lobes distinctly longitudinally sulcate----20. **sulcatilobus**, new species.
Mandibles white; frontal horn entirely black; parapsidal lobes at most weakly sulcate----21. **saladonis**, new species.
27. Face and orbits black----28.
Face and at least frontal orbits white----32.
28. Propodeum partly black; large species----29.
Propodeum entirely red or with apophyses whitish; small species----30.
29. Clypeus black; annulus beginning on third flagellar joint; frontal horn conical; thorax laterally pale stramineous; apopyses very long and slender. 22. **proximannulatus**, new species.
Clypeus white; annulus beginning on fifth flagellar joint; frontal horn constricted near base; thorax laterally ferruginous; apophyses rather short and straight----23. **constricticlavus**, new species.
30. Tergites 2–6 apically white margined, broadly so medially; lower end of occipital carina separated from hypostomal carina by a small notch; apophyses rather short, compressed----24. **medialbus**, new species.
Tergites 2–6 at most narrowly ferruginous at apex; lower end of occipital carina separated from hypostomal carina by a broad deep furrow; apophyses long, slender, curved----31.
31. Clypeus white; frontal horn with two deep pits above at base. 25. **xanthothorax** Brullé.
Clypeus black; frontal horn without such pits--26. **atrinasutus**, new species.
32. Pleura and usually propodeum ferruginous----33.
Pleura and propodeum yellow or whitish, more or less marked with black----40.
33. Propodeum black or piceous basad of carina and usually beyond; hind femur black or piceous at least above----34.
Propodeum ferruginous, sometimes with a more or less distinct median black line; hind femur ferruginous----36.
34. Propodeum black only basad of carina; lateral areas of scutellum partly white----27. **cockerellae** Viereck.
Propodeum with black or piceous color extending beyond carina; lateral areas of scutellum entirely black----35.

35. Mandibles white; scutellum black medially_____28. **inquinatus**, new species.
Mandibles black; scutellum white medially__29. **mediotinctus**, new species.
36. Second tergite with a median white spot near base_____37.
Second tergite without a median white spot_____38.
37. Propodeum with a narrow median basal area defined by carinae and with a median black stripe_____30. **areolaris**, new species.
Propodeum impressed in basal middle but without a defined area; immaculate_____31. **circumfluens**, new species.
38. Head not constricted below eyes, mouth broader than narrowest width of face; mandibles black_____32. **manni**, new species.
Head constricted below eyes, mouth hardly as broad as narrowest width of face; mandibles white_____39.
39. Malar space hardly as long as basal width of mandible; posterior orbits with a narrow white line continuous over top of eye; apophyses of normal length, straight_____33. **confusus**, new species.
Malar space longer than basal width of mandible; posterior orbits black with a white spot; apophyses very long, curved____34. **copiosus** Cresson.
40. Mesosternum and middle and hind coxae dark ferruginous; propodeum deeply impressed in basal middle with a prominent rounded yellow elevation on each side of impression_____35. **colliculatus**, new species.
Mesosternum and coxae white or stramineous, the hind coxae frequently with a black stripe above; propodeum of other form_____41.
41. Second tergite white medially near base_____42.
Second tergite not white medially toward base_____46.
42. Mesoscutum immaculate black; occipital carina curving sharply mesad and meeting the hypostomal carina farther from base of mandible than the latter is broad at base_____36. **macer** Cresson.
Mesoscutum with two white lines in middle; occipital carina either interrupted below or meeting hypostomal carina not far from base of mandible _____43.
43. Scutellum white; occipital carina rather prominent below and not reaching hypostomal carina _____44.
Scutellum with only apex and carinae white; occipital carina complete or obsolete below _____45.
44. Subbasal white spot of second tergite transversely quadrangular; basal middle of propodeum narrowly impressed but without a basal area defined by carinae; wings hyaline_____37. **duplicatus**, new species.
Subbasal white spot of second tergite triangular; basal middle of propodeum with a narrow area defined laterally by carinae; wings slightly infumate_____38. **triangularis**, new species.
45. Occipital carina fading out below and not reaching hypostomal carina; apophyses long, slender, curved_____39. **major** Cresson.
Occipital carina complete to occipital carina; apophyses long, but stouter and straight_____40. **semialbus** (Cresson).
41. **montezuma** Cameron
46. Dark color of head and thorax reddish piceous rathern than black; frontal horn white at apex; transverse dark band behind basal carina of propodeum broadly confluent with lateral stripe_____42. **lituratus** Brullé.
Dark color of head and thorax black; frontal horn black; transverse dark band at most narrowly confluent with lateral stripe; metapleurum more or less coarsely punctate, especially in male_____47.
47. Hind femur black above, whitish below_____43. **collinus** Cameron.
Hind femur testaceous_____44. **neglectus** Cushman.

48. Space between hypostomal carina and lower end of occipital carina broad and very deep; dorsal margin of pronotum not prominent anteriorly; abdomen entirely red----------49.
This space not very broad and deep, occipital carina nearly or quite reaching hypostomal carina; dorsal anterior angle of pronotum very prominent; abdomen black and white----------50.
49. Head entirely black; thorax entirely ferruginous.
49. **bicarinatus**, new species.
Head black and white; thorax stramineous, black and white.
50. **univittatus** Cresson.
50. Thorax partly reddish----------51.
Thorax black and white----------53. **tricolor** Brullé.
51. Second terbite black in basal middle and at extreme apex; apophyses in female longer than basal width----------51. **paululus** Cresson.
Second tergite white at base and apex; apophyses low.
52. **humerosus**, new species.

Subgenus CRYPTANURIDIMORPHA Viereck

Cryptanuridimorpha VIERECK, Proc. U. S. Nat. Mus., vol. 46, 1913, p. 369. Genotype.—*Cryptanuridimorpha elegans* Viereck.
Cryptopterigimorpha VIERECK, Proc. U. S. Nat. Mus., vol. 46, 1913, p. 371. Genotype.—*Cryptopterigimorpha tubulifer* Viereck. (New synonymy.)

As indicated above, these two supposed genera are said by the author to differ only in the position of the second recurrent vein with relation to the second intercubitus, a character which shows marked variation in the typical subgenus.

The character by which Viereck distinguished them from *Polycrytus*, the high hypostomal carinae which meet along the median line, and which he professed to consider of tribal significance, shrinks to at most subgeneric value when the whole Mesostenine complex of genera is considered. In all other characters this group agrees with the typical subgenus.

1. POLYCYRTUS (CRYPTANURIDIMORPHA) ELEGANS (Viereck). (New combination)

Cryptanuridimorpha elegans VIERECK, Proc. U. S. Nat. Mus., vol. 46, 1913, p. 369, male.

Still known only from the unique type male.

Distinct from any other species known to me by its entirely black hind tibiae and basally black hind basitarsus, although in this respect it does not differ from *nigrotibialis* Szepligeti. Characteristic also are the large size, the conspicuous whitish hairs on the abdomen, and the position of the antennal annulus (joints 11–15 of the flagellum), this being usually several joints nearer the base. The hypostomal carinae are contiguous medially to a point nearly opposite the ventral articulation of the mandible.

2. POLYCYRTUS (CRYPTANURIDIMORPHA) CAPITATOR (Fabricius) Brullé. (New combination)

?Cryptus capitator FABRICIUS, Syst. Piez., 1804, p. 82, female.

Mesostenus (Polycyrtus) capitator BRULLÉ, His. Nat. Ins., Hym., vol. 4, 1846, p. 214, male.—SZEPLIGETI, Ann. Mus. Nat Hung., vol. 14, 1916, pp. 269, 274, female, male.

?Polycyrtus nigriventris CAMERON, Timehri: Journ. Roy. Agr. and Comm. Soc. Brit Guiana, vol. 1, 1911, p. 168, female.

Before me are three specimens (one female and two males) from French Guiana received from the Paris Museum, which appear to be the same as the species described under this name by Brullé. Spinola's identification of *capitator* is not the same species as the type nor is it the same as Brullé's, differing at least in having the face laterally white and the propodeum posteriorly punctate. Assuming, since Brullé makes no mention of the color, that the posterior femora in his specimen are red, it differs in this respect from the type of *captitator*, which has the femora black. This character is probably not always specific. In this respect the Fabrician type resembles more closely *inca*, new species, and that species may prove to be synonymous with *capitator*.

Ichneumon cephalotor Thunberg, synonymized by Dalla Torre with *capitator* is certainly not the same. It has the thorax black.

The same type of coloration occurs in the typical subgenus, and it may be that some or all of the forms referred to *capitator* really belong there.

Brullé's description of *capitator* and the description of *nigriventris* are so exactly similar that it seems probable that the two are the same.

As here identified *capitator* has the following characters:

Female.—Length 14 mm.

Head in front view with vertex strongly concave, eyes comprising nearly two-thirds total width of head at level of antennae, mouth barely as broad as shortest width of face, malar space slightly constricted just above base of mandible, hardly as long as basal width of mandible; diameter of ocellus three-fourths ocell-ocular line and twice postocellar line; frons deeply concave, horn long and rather slender, a small round tubercle above its base; temples from above concave, much less than half as long as short diameter of eye; occipital carina in side view convergent above with eye margin, not more prominent at lower extremity than elsewhere; hypostonal carinae contiguous to a point about opposite middle of malar space, the flanking grooves not especially deep and not separated from the cheeks by a carina, first joint of flagellum about eight times as long as its greatest thickness. Thorax polished, with a few weak punc-

tures in humeral angle of pronotum and on mesopleurum; pronotum with a high carina along its lower anterior margin but without epomiae, its upper margin impressed opposite notauli, furrow along its posterior margin distinctly foveolate below, obsoletely above; mesoscutal lobes high, not at all flattened on top; scutellum very high; mesopleural and prepectal furrows foveolate; propodeum polished, without sculpture, basal carina very strong, straight in middle, basal area slightly concave medially, apophyses short, compressed, situated about midway between carina and apex; areolet of normal form with recurrent slightly antefurcal, nervulus interstitial or nearly, subdiscoideus slightly above middle of postnervulus, nervellus broken distinctly below middle. Abdomen slender, postpetiole less than twice as wide as petiole; second tergite fully three times as long as broad at base and very slightly shorter than first tergite; abdomen toward apex with sparse long whitish hairs; ovipositor sheath distinctly less than twice as long as first segment.

Thorax, legs, and first segment of abdomen except apex ferruginous to testaceous; head, antennae, and abdomen black; clypeus, mandibles, palpi, and antennal annulus beginning at apex of fourth flagellar joint white (the antennae are missing beyond this point); hypostomal carinae stramineous; legs beyond femora yellowish, the posterior tarsi whitish, apex dark; wings yellowish hyaline, venation dark, radices and tegulae stramineous; gastrocoeli pale reddish; tergites beyond first narrowly reddish at apex and more broadly whitish laterally, venter whitish.

Male.—Essentially like female. Antennal annulus beginning on apex of sixth flagellar joint; apophyses shorter and nearer to apex than to carina; propodeum obsoletely roughened behind and between the apophyses; abdomen narrower. One specimen has a trace of a median groove between apophyses and carina.

3. POLYCYRTUS (CRYPTANURIDIMORPHA) ALBINICLAVUS, new species

Figure 1

Female.—Length 12 mm.

Very closely related to *capitator* (Fabricius) Brullé and perhaps not specifically distinct. The following differences, however, are noted: the eyes appear somewhat smaller in front view; the small tubercle above the frontal horn is replaced by two transverse ridges traversing a shallow impression that is defined laterally by obsolete dorsally diverging ridges; frontal horn white. Antennae broken.

Type-locality.—Gourdonville, French Guiana.

Type.—Paris Museum.

One specimen taken by R. Benoist in 1914.

Would perhaps be better treated as a variety of *capitator* (Fabricius) Brullé, but limited material renders its treatment as a distinct species advisable for the present.

4. POLYCYRTUS (CRYPTANURIDIMORPHA) INCA, new species

?*Cryptus capitator* FABRICIUS, Syst. Piez., 1804, p. 82, female.

Female.—12 mm.

Like the last species above, perhaps no more than a variety of *capitator* (Fabricius) Brullé, but differs from that species as follows: furrow between hypostomal carina and cheek deep and carinately defined; lateral lobes of mesoscutum flattened; apophyses longer and distinctly nearer to apex of propodeum than to carina; antennal annulus beginning near base of fourth flagellar joint; frontal horn white; hind femur largely blackish.

Type-locality.—Caja, Peru.

Type.—Cat. No. 42174, U.S.N.M.

One specimen taken by Dr. P. Weiss.

As suggested above, this may be the true *capitator* (Fabricius).

5. POLYCYRTUS (CRYPTANURIDIMORPHA) TUBULIFERA (Viereck). (New combination)

Cryptopterigimorpha tubulifera VIERECK, Proc. U. S. Nat. Mus., vol. 46, 1913, p. 371, female.

Known only from the unique female type.

Very distinct in coloration from any other species of the subgenus, the head and anterior portion of the thorax being immaculate black and the rest of the body and the legs pale reddish testaceous.

Female.—Vertex and frons deeply concave, latter with rather distinct scrobes and a short thick horn without tubercle or ridges at base; eyes very nearly parallel within and comprising very nearly two-thirds of width of head at level of antennae; face with a rather deep longitudinal impression on each side of middle; clypeus in profile concavely inflexed at apex; malar space subequal to basal width of mandible; hypostomal carinae contiguous to nearly opposite ventral articulation of mandible; the flanking grooves separated from cheeks by carinate margins; temples concave and very narrow. Pronotum above, mesoscutum anteriorly, and mesopleurum and sternum sparsely and rather coarsely punctate; pronotum strongly carinate along its anterior lateral margin and deeply impressed on dorsal margin opposite notauli; lobes of mesoscutum not especially elevated, metapleurum irregularly rugose; propodeum with carina straight and very high, basal area punctate, not or barely impressed medially, apical slope medially more or less longitudinally roughened, apophyses very long; second recurrent and nervulus antefurcal; postnervulus broken at middle, nervellus broken at lower third; legs, especially

hind femur, rather unusually slender. Abdomen with rather dense long hair toward apex; postpetiole hardly twice as broad as petiole; second tergite distinctly shorter than first, more than three times as long as basal width; sheath a half longer than first tergite.

Head, pronotum, mesoscutum, basal portion of lateral area of scutellum, humeral angles of mesopleurum, and tegulae basally black; clypeus reddish at top of elevation; mandibles, palpi, and antennal annulus (flagellar joints 3–11) white; scutellar carinae white; thorax otherwise and abdomen pale reddish testaceous; legs to knees testaceous, beyond yellowish, hind tarsi whitish; wings yellowish hyaline, veins dark, stigma stramineous.

6. POLYCYRTUS (CRYPTANURIDIMORPHA) BUSCKI, new species

Very distinct in its entirely red thorax and abdomen from any other species of the subgenus and also in having the hypostomal carinae less highly developed though of the same form.

Female.—Length, 12 mm.

Head structurally about as in *capitator* (Fabricius) Brullé except that the hypostomal carinae are approximate (not quite meeting) for only a short distance basally. Thorax as in *capitator* except that the lateral lobes of the mesoscutum are slightly flattened, scutellum not quite so high, propodeal carina bent slightly forward medially, apophyses somewhat more prominent, postnervulus broken at middle. Abdomen slightly stouter than in *capitator*, postpetiole practically twice as broad as petiole, second tergite barely thrice as long as broad at base, much less conspicuously hairy at apex.

Head black with face, frontal and superior orbits, small spot in posterior orbits, malar space, clypeus, mandibles, palpi, frontal horn, and antennal annulus (middle of flagellar joints 4–11) white; thorax, abdomen, and legs ferruginous, tibiae yellowish, hind tarsi white; wings pale yellowish hyaline, veins dark, stigma largely stramineous.

Male.—Essentially like female; postorbital spot larger, scape partly white below, annulus on flagellar joints 7 (apical half) to 15; apophyses shorter and slightly nearer apex then to carina.

Type-locality.—Trinidad Rio, Panama.

Type.—Cat. No. 42175, U.S.N.M.

Two of each sex, all collected by August Busck, the type March 30, 1912, the allotype May 9, 1911, and the paratype male January 2, 1912, all at the type-locality, the paratype female at Porto Bello, Panama, March 13, 1911.

The paratype female is smaller than the type, has the face medially brownish, lacks the postorbital white spot, and has the annulus occupying the whole of joints 4–10 and base of 11; it lacks the front wings.

Subgenus POLYCYRTUS Spinola

Polycyrtus SPINOLA, Ann. Soc. Ent. France, vol. 9. 1840, p. 154. *Genotype.*—*Polycyrtus histrio* Spinola.

Polycyrtimorpha VIERECK, Proc. U. S. Nat. Mus., vol. 46, 1913, p. 383. *Genotype.*—*Polycyrtimorpha amoenus* Viereck.

As here treated this subgenus is a somewhat heterogeneous group that might, perhaps, be divided into two or more subgenera. The group comprising the last five species, characterized by the complete apical carina and apophyses reduced to higher portions in the carina, is apparently as distinct from the rest of the species as is the subgenus *Cryptanuridimorpha* although the character is not intrinsically so strong. Similarly *carinispinis*, *bulbosus*, *infractus*, and *rufipleuris* apparently are isolated examples of other minor groups that might, perhaps, be elevated to subgeneric rank.

The unavailability of the complete or incomplete occipital carina as a generic or even a subgeneric character, as used by Viereck to separate his *Polycyrtimorpha* from *Polycyrtus*, is demonstrated by the fact that it would divide the otherwise compact group of species with complete apical carina. In the foregoing key to species I have used this character in a modified form for the separation of species or small groups of species.

7. POLYCYRTUS (POLYCYRTUS) ORNATIFRONS, new species

Female.—Length 13 mm.

Vertex in front view deeply concave; frons with scrobes deep but not defined on inner side; horn slender with apex rounded and with two pits on frons above its base; face distinctly punctate, longitudinally impressed on each side of middle; eyes convergent below, comprising nearly two-thirds width of head at level of antennae; malar space distinctly shorter than basal width of mandible, constricted, mouth a little wider than narrowest width of face; temples in side view very narrow, occipital carina convergent above with posterior margin of eye, prominent below and separated from hypostomal carina by a deep groove; temples from above concave, weakly oblique, less than a third as long as short diameter of eye; diameter of an ocellus nearly three-fourths as long as ocell-ocular line and nearly twice postocellar line; basal joint of flagellum about seven times as long as thick. Thorax polished, mesopleurum sparsely punctate, metapleurum obliquely rugose; pronotum with a high elevation on its anterior lateral margin surmounted by a high carina, epomia wanting; prescutum rather low, lateral lobes somewhat flattened; scutellum high, compressed;

subalar tubercle carinate; propodeum medially impressed from base to apophyses with a rounded elevation on each side at base, carina high and strongly curved medially, spiracles elongate, apophyses moderately long, straight, compressed, about midway between carina and apex; hind femur nearly twice as thick in middle as at apex, inner calcarium nearly half as long as basitarsus; areolet rather broad with recurrent shortly antefurcal, nervulus nearly interstitial, postnervulus broken a little above middle, nervellus broken above lower third. Abdomen minutely alutaceous; second tergite a little more than three times as long as broad at base and nearly as long as first; sheath about as long as hind tibia.

Head black and white; thorax and abdomen entirely and legs largely ferruginous; frontal and superior orbits, face, except medially, clypeus, mandibles, maxillary palpi, and annulus embracing flagellar joints 5–10 white, labial palpi reddish fuscous; hind femur piceous, darker above toward apex, tibia yellow, tarsus whitish; wings yellowish hyaline, veins black, stigma somewhat paler.

Type-locality.—Porto Bello, Panama.

Type.—Cat. No. 42176, U.S.N.M.

One specimen taken April 18, 1912, by August Busck.

8. POLYCYRTUS (POLYCYRTUS) INORNATUS, new species

Female.—Length 11 mm.

Differs from above description of *ornatifrons* as follows: Vertex weakly concave; frontal horn stout conical; mouth hardly as broad as narrowest width of face; temples from above more than a third as long as short diameter of eye; basal joint of flagellum fully eight times as long as thick. Anterior lateral margin of pronotum not at all prominent, carina strong, epomia short but distinct; mesopleurum impunctate, metapleurum weakly punctate; propodeum not at all impressed and without basal elevations, carina nearly straight medially, spiracles rather broadly oval, apophyses stouter, subconical, not compressed; inner hind calcarium about two-fifths as long as basitarsus, areolet small, recurrent strongly antefurcal, postnervulus broken at middle. Second tergite barely three times as long as broad at base and considerably shorter than first; sheath only about two-thirds as long as hind tibia.

Head including mandibles entirely black; palpi stramineous, the labial palpi darker; annulus beginning on fourth joint of flagellum; hind femur ferruginous.

Type-locality.—Rio Trinidad, Panama.

Type.—Cat. No. 42177, U.S.N.M.

One specimen taken March 27, 1912, by August Busck.

9. POLYCYRTUS (POLYCYRTUS) MINUTUS, new species

Female.—Length 6.5 mm.

Differs from above description of *ornatifrons* as follows: Vertex in front view straight; scrobes shallow, and partly defined on inner side by carinae running upward from each side of horn, latter short conical; face smooth; mouth barely as wide as narrowest width of face; temples from above nearly flat, about a third as long as short diameter of eye; diameter of ocellus hardly two-thirds as long as postocellar line; basal joint of flagellum slightly more slender, anterior lateral margins of pronotum not prominent, the carina rather low, epomia short but evident; mesopleurum and metapleurum practically unsculptured, propodeum not at all impressed, carina nearly straight medially, spiracles oval, apophyses short conical; areolet small; sheath about two-thirds as long as hind tibia.

Head black, clypeus, mandibles, and scape piceous, palpi pale stramineous; hind femur ferruginous; wings hyaline, veins brown, stigma stramineous.

Male.—Apophyses reduced to low tubercles; second tergite four times as long as broad at base; annulus on flagellar joints 8–14.

Type-locality.—Braganza, Para, Brazil.

Type.—Cat. No. 42178, U.S.N.M.

Allotype.—Paris Museum.

One of each sex, the type female taken by Miss H. B. Merrill, and the allotype male from Serra dos Orgaos, Province of Rio Janeiro, Brazil, where it was taken in March, 1902, by E. R. Wagner.

10. POLYCYRTUS (POLYCYRTUS) BOLIVIENSIS, new species

Female.—Length 9 mm.

Differs from the above description of *ornatifrons* as follows: Vertex in front view straight; frontal scrobes shallow, horn conical, the two pits above its base flanked outwardly by short strong carinae and separated by a prominent tubercle; face only obsoletely punctate; mouth barely as broad as narrowest width of face; temples from above nearly flat; barely a fourth as long as short diameter of eye; diameter of an ocellus nearly as long as ocell-ocular line and fully twice as long as postocellar line; basal joint of flagellum somewhat more slender. Metapleurum coarsely, subobsoletely punctate; anterior lateral margins of pronotum not prominent, the carina rather low; prescutum low and distinctly flattened; propodeum not impressed and without basal elevations, carina nearly straight medially, spiracles oval, apophyses a little nearer to carina than to apex; inner calcarium two-fifths as long as basitarsus; areolet small, recurrent strongly antefurcal. Abdomen polished; second tergite barely three times as long as broad at base, considerably shorter than first; sheath a little more than two-thirds as long as hind tibia.

Head black with only clypeus, mandibles, and annulus (middle of joint 4-joint 12) white, palpi stramineous; hind femur ferruginous; stigma pale.

Male.—Temples from above a third as long as short diameter of eye; apophyses reduced to low tubercles, much closer to apex than to carina; second tergite three and a half times as long as broad at base; pubescence of abdomen nearly black (reddish in female); annulus embracing flagellar joints 7–20.

Type-locality.—Canamina, Bolivia.

Type.—Cat. No. 42179, U.S.N.M.

Two of each sex collected in July by W. M. Mann on the Mulford Biological Exploration of 1921–22.

Very closely allied to *minutus* Cushman, from which it is at once distinguishable by its white clypeus and mandibles.

11. POLYCYRTUS (POLYCYRTUS) AREOLATUS, new species

Female.—Length 12 mm.

Differs from above description of *ornatifrons* as follows: Frontal horn small conical; frons above its base without pits or carinae; face impunctate; malar space fully as long as basal width of mandible, mouth barely as broad as narrowest width of face; occipital carina parallel with posterior margin of eye, not reaching hypostomal carina but its lower end not prominent, the space between it and hypostomal carina shallow; temples from above more than a third as long as short diameter of eye; diameter of an ocellus barely two-thirds as long as ocell-ocular line and not nearly twice as long as postocellar line; basal joint of flagellum somewhat more slender. Anterior lateral elevation of pronotum not so high, epomia short but distinct; lobes of mesoscutum convex; propodeum impressed only weakly basad of carina and without elevations flanking the impression, carina nearly straight medially, spiracles oval, apophyses long, curved, slightly nearer to apex than to carina, apical slope very steep; hind femur fully twice as thick in middle as at apex, inner calcarium barely a third as long as basitarsus; areolet very small, recurrent nearly interstitial. Second tergite only about two and a half times as long as broad at base and much shorter than first; sheath hardly two-thirds as long as hind tibia.

Head black, clypeus, mandibles, palpi, and annulus from middle of fourth joint of flagellum to eleventh joint white; hind femur ferruginous.

Type-locality.—Alhajuelo, Panama.

Type.—Cat. No. 42180, U.S.N.M.

One specimen taken April 7, 1911, by August Busck.

12. POLYCYRTUS (POLYCYRTUS) NIGRICLYPEATUS, new species

Female.—Length 13 mm.

Vertex in front view concave; frons with rather deep scrobes, horn stout conical with two small pits above base; eyes convergent below, comprising nearly two-thirds total width of head; face polished, with a median elevation, malar space much longer than basal width of mandible, slightly constricted, mouth hardly as broad as narrowest width of face; occipital carina in profile slightly convergent above with posterior margin of eye, very prominent below and separated from hypostomal carina by a deep groove; temples strongly concave, oblique, about a third as long as short diameter of eye; diameter of an ocellus little more than half as long as ocell-ocular line, but fully a half longer than postocellar line; basal joint of flagellum nearly ten times as long as thick. Thorax polished; anterior lateral carina of pronotum not especially high, epomia absent; prescutum elevated, lateral lobes of mesoscutum somewhat flattened; scutellum high, compressed; prepectal furrow only obsoletely foveolate; metapleurum obsoletely punctate in middle; propodeum medially impressed, especially basally where the impression is flanked by high rounded elevations, carina slightly curved medially, spiracles elongate, apophyses long, curved, much nearer carina than apex; hind femur slender, much less than twice as thick in middle as at apex; inner calcarium a little more than a third as long as basitarsus; areolet narrow, recurrent and nervulus interstitial or nearly; postnervulus broken in middle, nervellus at lower fourth. Abdomen narrow, second tergite more than four times as long as broad at base, broadly constricted near base, nearly as long as first; sheath almost exactly as long as hind tibia.

Head black with only mandibles, palpi, and flagellar joints 5–10 white, basal joint of maxillary palpus piceous; thorax immaculate ferruginous; legs concolorous, front pair paler, front and middle tarsi apically infuscate, hind femur black except at base, tibia yellowish, tarsus whitish; wings hyaline, veins and stigma black; abdomen black, petiole ferruginous, other tergites apically and laterally white, the apical bands angulately broadened medially; venter white, gastrocoeli reddish.

Type locality.—Rio Trinidad, Panama.

Type.—Cat. No. 42181, U.S.N.M.

One specimen taken March 29, 1912, by August Busck.

13. POLYCYRTUS (POLYCYRTUS) IMPRESSUS, new species

Female.—Length 12 mm.

Similar in form to *nigriclypeatus* as described above but differing as follows: Frontal horn almost subclavate in profile; malar

space distinctly shorter than basal width of mandible, not distinctly constricted, mouth as broad as narrowest width of face; temples flat; diameter of ocellus two-thirds as long as ocell-ocular line; basal joint of flagellum about eight times as long as thick. Prescutum low; prepectal furrow distinctly foveolate; metapleurum more distinctly punctate, rugose posteriorly; propodeal carina subangulate medially, apophyses short, obtuse, about midway between carina and apex; hind femur thick, about twice as thick in middle as at apex; areolet broad, recurrent antefurcal; nervellus broken above basal third.

Clypeus white, palpi entirely white; annulus beginning at base of fourth joint of flagellum; pleura and sternum distinctly paler than dorsum; tegulae and scutellar carinae stramineous; tergites not definitely white margined apically.

Type locality.—Cavinas, Beni, Bolivia.

Type.—Cat. No. 42182, U.S.N.M.

One specimen taken in January, 1922, by W. M. Mann on the Mulford Biological Exploration.

14. POLYCYRTUS (POLYCYRTUS) PROMINENS, new species

Female.—Length 14 mm.

Differs from the foregoing description of *nigriclypeatus* as follows: Frontal horn more slender, nearly cylindrical, rounded at apex; face faintly alutaceous, malar space much shorter than basal width of mandible, hardly constricted, mouth fully as broad as narrowest width of face; basal joint of flagellum eight times as long as thick. Anterior lateral angles of pronotum very prominent, the carina high; prescutum low, prepectal furrow distinctly foveolate; metapleurum rugoso-punctate in middle; propodeum less deeply impressed, the basal elevations not so high, carina more strongly curved medially, apophyses shorter, straight, compressed, fully as close to apex as to carina; hind femur nearly twice as thick in middle as at apex; inner calcarium two-fifths as long as basitarsus; areolet rather broad, recurrent antefurcal; nervulus postfurcal, post-nervulus broken slightly above middle, nervellus above basal fourth; second tergite little more than three times as long as broad at base, considerably shorter than first; sheath distinctly shorter than hind tibia.

Face and clypeus as well as mouthparts white; pleura and sternum paler than dorsum; wings more yellowish; apical white bands of tergites of nearly uniform width.

Type locality.—Rurrenabaque, Rio Beni, Bolivia.

Type.—Cat. No. 42183, U.S.N.M.

One specimen from the Mulford Biological Exploration taken by W. M. Mann, October, 1921.

15. POLYCYRTUS (POLYCYRTUS) CONVERGENS, new species

Female.—Length 15 mm.

Differs from foregoing description of *nigriclypeatus* as follows: Vertex in front view very strongly concave; frontal horn more slender, cylindrical with apex rounded; the pits above base large, face sparsely weakly punctate and with an obliquely longitudinal impression on each side rather than a median elevation; malar space much shorter than basal width of mandible; mouth fully as broad as narrowest width of face; diameter of an ocellus two-thirds as long as ocell-ocular line; first flagellar joint hardly eight times as long as thick. Anterior lateral margin of pronotum strongly angulate, the carina high; prescutum low; metapleurum distinctly though sparsely punctate in middle; propodeum much more shallowly impressed, the impression extending only a short distance behind the carina, basal elevations much less prominent, carina more strongly bent medially, apophyses much shorter, straight, compressed, midway between carina and apex; hind femur nearly twice as thick in middle as at apex; inner calcarium two-fifths as long as basitarsus; areolet rather broad, recurrent antefurcal, nervellus broken just above lower third. Second tergite about three and one-half times as long as broad at base; sheath distinctly shorter than hind tibia.

Face and clypeus as well as mouthparts white; annulus beginning on fourth joint of flagellum; apex of scutellum and postscutellum blackish; petiole largely black above, pale below; extreme apex of pospetiole white, apical white bands of other tergites of uniform width, not broadened medially.

Type-locality.—Yarhuarmayo, Peru.

Type.—Cat. No. 42184, U.S.N.M.

One specimen taken by C. H. T. Townsend.

16. POLYCYRTUS (POLYCYRTUS) ISTHMUS, new species

Female.—12 mm.

Vertex in front view shallowly concave; frons with scrobes deep but not defined on inner side, horn stout, conical, with a tubercle above its base; eyes convergent below and comprising nearly two-thirds total width of head at antennae; face shining, minutely alutaceous and sparsely punctate, shallowly impressed on each side of middle; malar space much shorter than basal width of mandible, hardly constricted, mouth fully as broad as narrowest width of face; temples in side view broad, convergent above with posterior margin of eye, occipital carina very high below, where it recurves sharply to meet the hypostomal carina far beyond middle of latter with a narrow notch just before the junction, hypostomal carina very high

beyond and low before junction; temples from above strongly concave, little more than a fourth as long as short diameter of eye; diameter of an ocellus hardly two-thirds as long as ocell-ocular line; basal joint of flagellum about seven times as long as thick. Thorax polished, virtually impunctate; anterior lateral margin of pronotum prominent and with a moderately high carina, epomia complete and very strong; prescutum rather prominent, lateral lobes somewhat flattened and longitudinally subsulcate; prepectal furrow not foveolate; subalar tubercle carinate; metapleurum with a few minute punctures; propodeum weakly longitudinally impressed medially, with a low elevation on each side of middle basally, carina arching sightly forward in middle, spiracle elongate oval, apophyses short, stout, compressed, nearer to carina than to apex; hind femur hardly twice as thick in middle as at apex, inner calcarium hardly three-fifths as long as basitarsus; areolet rather small, broad and short, recurrent strongly antefurcal, nervulus antefurcal, postnervulus broken slightly above middle, nervellus at lower third. Abdomen polished; second tergite about three times as long as broad at base, nearly as long as first; sheath about three-fourths as long as hind tibia.

Head and abdomen black and white, thorax ferruginous: face except medially, clypeus, mandibles, malar space and lower cheeks, frontal and superior orbits, maxillary palpi, annulus embracing flagellar joints 5–12 and apex of 4, apical margins of all tergites, and lateral margins of all but first two, and hind tarsus white; petiole ferruginous; hind femur piceous, tibia yellow, legs otherwise ferruginous; wings hyaline, veins black, stigma brown.

Type-locality.—Rio Trinidad, Panama.

Type.—Cat. No. 42185, U.S.N.M.

One specimen taken March 23, 1912, by August Busck.

17. POLYCYRTUS (POLYCYRTUS) PARVICLAVUS, new species

Female.—Length 12 mm.

Vertex in front view weakly concave; frons with poorly defined scrobes, horn very short, conical; eyes strongly convergent below, comprising distinctly less than two-thirds total width of head at level of antennae: face polished, rather deeply impressed each side of middle: malar space distinctly shorter than basal width of mandible, constricted, mouth barely as broad as narrowest width of face: occipital carina parallel with posterior margin of eye, recurving at lower end to join hypostomal carina and with a very small notch just before junction, hypostomal carina rather low: temples from above oblique, flat, nearly half as long as short diameter of eye: diameter of an ocellus less than two-thirds ocell-ocular line and only a little longer than postocellar line: basal joint of flagellum about

ten times as long as thick. Thorax polished; anterior lateral margin of pronotum not prominent, the carina low; epomia obsolete; prescutum convex, lateral lobes flattened; scutellum high, strongly compressed; mesopleural furrows weakly foveolate; propodeum weakly triangularly impressed in basal middle, carina broadly arched toward front, spiracles elongate, apophyses short conical, widely separated, nearer to carina than to apex, space between flat; hind femur less than twice as thick in middle as at apex; inner calcarium nearly two-fifths as long as basitarsus; areolet rather narrow, recurrent and nervulus antefurcal, postnervulus broken in middle, nervellus broken at lower fourth. Abdomen very slender, second tergite about five times as long as broad at base and as long as first, broadly constricted near base; sheath about one and a half times as long as hind tibia.

Head black; clypeus reddish yellow; mandibles whitish along front margin; maxillary palpi stramineous; labial palpi fuscous; antennae (broken) with a broad white annulus beginning on fifth flaggellar joint; thorax ferruginous, immaculate; legs testaceous to stramineous, hind femur black, trochanters partly piceous, tibia yellowish, tarsus whitish, front and middle tarsi dark apically; wings rather strongly yellowish infumate, venation black, stigma paler, tegulae ferruginous; abdomen black, first segment ferruginous except at apex; other tergites narrowly white at apex, more broadly so laterally, gastrocoeli red.

Type-locality.—Rio Charape, Peru.

Type.—Cat. No. 42186, U.S.N.M.

One specimen taken September 13, 1911, by C. H. T. Townsend.

18. POLYCYRTUS (POLYCYRTUS) PARANENSIS, new species

Female.—Length 12 mm.

Compared with the above description of *parviclavus* differs as follows: Frontal horn larger and stout conical; eyes weakly convergent, comprising nearly two-thirds total width of head at antennae; occipital carina in side view convergent above with posterior margin of eye, more prominent and with a deep notch just before its junction with the hypostomal carina, latter high beyond junction; temples hardly a third as long as short diameter of eye; diameter of an ocellus fully two-thirds as long as ocell-ocular line and much longer than postocellar line; basal joint of flagellum not quite so slender. Anterior lateral carina of pronotum high; epomia strong below, obsolete above; mesopleural furrow distinctly foveolate; metapleurum obliquely rugose in posterior half; spiracles broadly oval; apophyses rather long, compressed; areolet rather

small, short, nervulus antefurcal, nervellus broken at lower third. Abdomen stouter, second tergite only about three times as long as broad at base, distinctly shorter than first; sheath hardly as long as hind tibia.

Clypeus and mandibles white; maxillary palpi white, labial palpi testaceous; hind femur farruginous.

Type-locality.—Para, Brazil.

Type.—Cat. No. 42187, U.S.N.M.

One specimen taken by Miss H. B. Merrill.

19. POLYCYRTUS (POLYCYRTUS) BREVIGENALIS, new species

Female.—Length 11 mm.

Vertex in front view concave; frons with scrobes rather deep, horn long, rather slender, obtuse at apex, with two pits above at base; eyes weakly convergent below and comprising nearly two-thirds total width of head at level of antennae; face minutely alutaceous and distinctly punctate, impressed on each side of middle; malar space much shorter than basal width of mandible, constricted, mouth hardly as broad as narrowest width of face; temples in side view slightly convergent above with posterior margin of eye, occipital carina low, not reaching hypostomal carina, from which its lower end is separated by a broad, shallow groove, hypostomal carina rather high; temples from above flat, very weakly oblique, barely a fourth as long as short diameter of eye; diameter of an ocellus about two-thirds as long as ocell-ocular line. Thorax polished, anterior lateral margin of pronotum with a rather prominent elevation, the carina high, eponia short but distinct; prescutum strongly convex, lateral lobes slightly flattened; scutellum high, compressed; mesopleurum practically impunctate, prepectal furrow obsoletely foveolate, subalar tubercle carinate; propodeum flattened in basal middle, carina high and perfectly straight medially, spiracle elongate oval, apophyses long, slender, curved, midway between carina and apex; hind femur nearly twice as thick in middle as at apex, inner calcarium a little more than a third as long as basitarsus; areolet of normal form, recurrent antefurcal, nervulus interstitial, postnervulus broken in middle, nervellus at lower third. Abdomen polished, minutely alutaceous beyond second tergite, second tergite about four times as long as broad at base, as long as first, broadly constricted near base; sheath not quite so long as hind tibia.

Head black; clypeus, mandibles, and maxillary palpi white; labial palpi testaceous; annulus from middle of fourth joint of flagellum to eleventh joint; thorax and legs ferruginous, hind femur dark piceous, tibia yellow, tarsus white; wings hyaline, veins brown,

stigma paler; abdomen black, first segment largely ferruginous, other tergites apically and laterally white.

Type-locality.—Trinidad Rio, Panama.

Type.—Cat. No. 42188, U.S.N.M.

One female taken June 6, 1912, by August Busck.

20. POLYCYRTUS (POLYCYRTUS) SULCATILOBUS, new species

Female.—Length 13 mm.

Vertex in front view flat; frons with scrobes shallow, horn very thick conical with a large pit on each side of its dorsal surface; eyes weakly convergent below, comprising much less than two-thirds total width of head; face shallowly impressed on each side of middle, minutely alutaceous, distinctly, sparsely punctate above; malar space as long as basal width of mandible, cheeks in front view convex, mouth as broad as narrowest width of face; temples in side view very broad, occipital carina convergent above with posterior margin of eye, rather low, straight and joining hypostomal carina at its outer third, latter very high beyond junction; diameter of an ocellus hardly two-thirds as long as ocell-ocular line and shorter than postocellar line. Thorax polished; pronotum longitudinally striate in middle of posterior margin, anterior lateral margin with the carina high, epomia strong and forming a carinate angle at anterior end of welt-like humeral margin; prescutum rather low; lateral lobes each with a deep sulcus in middle; scutellum not elevated; prepectal carina obsolete above; subalar tubercle not carinate; metapleurum sparsely punctate anteriorly, obliquely rugose posteriorly; propodeum medially impressed basally as far as apophyses, carina curving sharply forward medially, spiracle elongate oval, apophyses stout conical, closer to carina than to apex; hind femur much less than twice as thick in middle as at apex, inner calcarium two-fifths as long as basitarsus; areolet normal, recurrent and nervulus antefurcal, postnervulus broken at middle, nervellus at lower third. Abdomen stout, second tergite two and a half times as long as broad at base, much shorter than first; sheath slightly shorter than hind tibia.

Head black; orbits, temples, cheeks and malar space, palpi, apex of horn, and annulus on flagelar joints 6–12 and apex of 5 white; prothorax black and white, the propleura and lower and humeral margins of pronotum broadly white; mesoscutum black with two lines on disk white; scutellum apically and the carinae white; post-scutellum white, the lateral areas black; mesopleurum ferruginous with upper margin black and a large triangular spot in upper anterior angle white; metapleurum ferruginous with a white spot in its upper division; propodeum ferruginous; legs ferruginous with

hind tibia slightly paler and tarsus yellowish; wings hyaline, veins brown, stigma paler, tegulae white; abdomen ferruginous.

Type-locality.—Pernambuco, Brazil.

Type.—Cat. No. 42189, U.S.N.M.

One specimen, March 1, 1883.

21. POLYCYRTUS (POLYCYRTUS) SALADONIS, new species

Female.—Length 13 mm.

Very similar to *sulcatilobus*, from the foregoing description of which it differs only as follows: Occipital carina in side view parallel with posterior margin of eye; lateral lobes of mesoscutum obsoletely sulcate; upper anterior angle of mesopleurum longitudinally rugose; metapleurum rugose over most of its area; propodeum rugose punctate apically, impressed only basad of carina, apophyses long; hind femur even more slender. Mandibles white; frontal horn entirely black; orbits narrowly interrupted behind top of eye.

Male.—Antennal annulus beginning on seventh flagellar joint; apophyses very short conical; metapleurum smooth. Otherwise, except sexually, like female.

Type-locality.—Chaco de Santiago del Estero, Rio Salado, near d'Icano, Argentina.

Type.—Paris Museum.

Allotype.—Cat. No. 42190, U.S.N.M.

One of each sex collected by E. R. Wagner in 1904.

22. POLYCYRTUS (POLYCYRTUS) PROXIMANNULATUS, new species

Figure 2

Female.—Length 14 mm.

Vertex and frons concave, horn large conical with an obscurely defined impression on frons and above its base; eyes distinctly convergent below and comprising distinctly less than two-thirds total width of head; face slightly raised medially, impressed above on each side; malar space slightly longer than basal width of mandible, constricted above base of mandible; mouth hardly as broad as narrowest width of face; occipital carina slightly convergent above with posterior margin of eye, very prominent below and separated by a broad deep furrow from hypostomal carina, latter moderately high and curving outward at its highest point (fig. 2); temples rather weakly oblique, strongly concave, hardly a third as long as short diameter of eye; diameter of lateral ocellus two-thirds ocellocular line, much less than twice postocellar line; first joint of flagellum fully eight times as long as apical thickness. Thorax polished, vir-

tually without sculpture except metapleurum, which is irregularly transversely rugose; pronotum not tumid on dorsal margin, lateral anterior margin with a high carina, epomia present, short; prepectus high, lateral lobes flattened, notauli confluent posteriorly; scutellum very high, strongly compressed; mesopleural furrow distinctly, prepectal furrow obscurely, foveolate, subalar tubercle low and with a weak carina traversing its summit; propodeum polished, unsculptured, basal middle triangularly flattened with anterior angles prominent, spiracles large, broadly oval, basal carina very high sinuate, apophyses very long, slender, curved, and situated much nearer carina than apex; hind femur distinctly thicker in middle than at ends; inner calcarium about two-fifths as long as basitarsus; areolet only a little longer than broad, recurrent antefurcal, nervulus interstitial, postnervulus broken at middle, nervellus broken at lower fourth. Abdomen rather broad, rather densely clothed with long white hair, first tergite and base of second narrow, second much shorter than first, more than three times as long as broad at base, postpetiole hardly twice as broad as petiole; sheath as long as hind tibia and nearly twice as long as first tergite.

Head black; mandibles partly, palpi and annulus extending from near base of third to fifteenth flagellar joint white; thorax pale reddish stramineous; pronotum in dorsal middle, mesoscutum, scutellum and postscutellum black; scutellar carinae white; propodeum basad of carina and between spiracles dark piceous, medially behind carina slightly stained; front and middle legs stramineous, femora posteriorly darker, the front femur testaceous and middle femur piceous, tarsus blackish apically; hind coxa pale testaceous, trochanter and femur piceous, the femur nearly black, tibia and tarsus whitish, the tibia tinged with yellow; wings hyaline, faintly yellowish, venation black with stigma pale along middle, tegulae stramineous with a white longitudinal stripe, apex piceous; abdomen black dorsally, white laterally and ventrally.

Type-locality.—Canamina, Bolivia.

Type.—Cat. No. 42191, U.S.N.M.

One specimen taken in July by W. M. Mann on the Mulford Biological Exploration of 1921–22.

23. POLYCYRTUS (POLYCYRTUS) CONSTRICTICLAVUS, new species

Female.—Length 14 mm.

Vertex hardly concave in straight front view, but with a rather deep impression on each side of ocellar area; frons with distinct scrobes bounded on the outer side by ridges and on the inner side by the subcarinate margins of a median impression, frontal horn stout, obtuse at apex with a deep constriction toward base, basad of

which on the upper side are two deep pits separated by a thick ridge; eyes convergent below, comprising nearly two-thirds total width of head; face sparsely punctate, very finely coriaceous, subopaque, with a deep, narrow impression each side of middle; malar space opaque, much shorter than basal width of mandible, slightly concave; mouth as broad as narrowest width of face; occipital carina convergent above with posterior margin of eye, prominent below and separated by a deep, rather narrow furrow from hypostomal carina, latter high apically; temples flat, very weakly oblique, barely a fourth as broad as short diameter of eye; diameter of ocellus three-fourths ocell-ocular line and about twice postocellar line; first joint of flagellum about eight times as long as thick at apex. Thorax polished, with a few scattered punctures on pronotum and mesopleurum and the metapleurum strongly obliquely rugose, this rugosity extending to the sides of the propodeum behind the apophyses; pronotum tumid above with impressions opposite the notauli; anterior marginal carina very high, epomia absent; prescutum moderately high, lateral lobes slightly flattened, notauli not confluent; scutellum moderately high, compressed, lateral areas very deeply impressed, with a few large foveolae at bottom of impression; mesopleural and prepectal furrows foveolate, upper portion of prepectus and humeral angle of mesopleurum rugulose, subalar tubercle very low, surrounded by a strong carina; propodeum polished, basal middle concave, carina high, bent forward medially, spiracles large, elongate; apophyses short, stout, very slightly nearer to carina than to apex, space between carina and apophyses with a narrow median channel and a few obscure posteriorly convergent rugae; hind femur rather stout, nearly twice as thick in middle as at extremities; inner calcarium two-fifths as long as basitarsus; areolet rather short, recurrent and nervulus antefurcal; postnervulus broken below middle, nervellus broken very slightly below middle. Abdomen narrow, hairs sparse, fine and short; postpetiole barely twice as broad as petiole; second tergite a little shorter than first and about three times as long as broad at base; sheath shorter than hind tibia.

Head black; clypeus except margins, mandibles and annulus beginning at middle of fifth flagellar joint white; palpi stramineous; thorax reddish testaceous laterally and ventrally, pronotum medially, mesoscutum, scutellum, and postscutellum black, scutellar carinae white; propodeum basad of carina and medially behind carina piceous; legs stramineous to testaceous, the front and middle femora darker behind, their tarsi blackish apically; hind trochanter and femur blackish, tibia yellow, tarsus whitish; wings hyaline, faintly yellowish, venation black, tegulae stramineous, whitish on inner edge and piceous at apex; abdomen black dorsally, whitish laterally and ventrally.

Type-locality.—Serra dos Orgaõs, State of Rio Janeiro, Brazil.
Type.—In Paris Museum.
One specimen taken in 1902 at an altitude of 500–1,000 meters by E. R. Wagner.

24. POLYCYRTUS (POLYCYRTUS) MEDIALBUS, new species

Female.—Length 10 mm.

Vertex in direct front view not at all concave but with rather deep grooves flanking the lateral ocelli; frons with poorly defined scrobes but with a deep median furrow that forks above to about half surround the anterior ocellus and ends below in a deep pit above the base of the stout acutely pointed horn; eyes slightly convergent below and comprising distinctly less than two-thirds of total width of head; face polished with a shallow groove each side of middle; malar space opaque, hardly as long as basal width of mandible, slightly constricted; mouth hardly as broad as narrowest width of face; occipital carina very nearly parallel with posterior margin of eye, prominent below and with a small notch separating it from hypostomal carina, latter high apically; temples flat, oblique, more than a third as long as short diameter of eye; diameter of ocellus three-fourths ocell-ocular line and more than twice postocellar line; basal joint of flagellum hardly eight times as long as thick. Thorax polished, unsculptured except that metapleurum is obscurely roughened; pronotum with anterior lateral carina moderately high but without epomia, humeral margin somewhat tumid; prescutum rather low, lateral lobes slightly flattened; scutellum rather low, weakly compressed; mesopleurum with furrows foveolate and a few rugae in humeral angle; propodeum polished, carina rather low, bent slightly forward medially, spiracle small, nearly circular, apophyses of moderate size, midway between carina and apex; hind femur about twice as thick in middle as at extremities; inner calcarium two-fifths as long as basitarsus; areolet of normal form and size, recurrent strongly antefurcal, nervulus interstitial, postnervulus broken at middle, nervellus broken just above lower third. Abdomen rather slender, postpetiole barely twice as broad as petiole, second tergite a little more than three times as long as broad at base and very nearly as long as first; sheath broken but apparently much shorter than hind tibia.

Head black; clypeus except margins, mandibles, and annulus from middle of flagellar joint 5 to joint 11 white; palpi stramineous; thorax ferruginous; pronotum dorsally piceous; mesoscutum black, scutellum ferruginous with carinae and apex white, postscutellum and apophyses apically white; front and middle legs testaceous with front coxae anteriorly and tibiae stramineous, tarsi fus-

cous toward apex, hind coxa and trochanter testaceous, femur blackish, tibia yellow, tarsus white; wings faintly yellowish hyaline, venation dark, stigma pale in middle, tegulae piceous, whitish at base; abdomen black above, white laterally and ventrally, petiole pale reddish above, tergites 2–6 with a median apical white spot and more or less distinct narrow reddish to whitish margins.

Type-locality.—Serra dos Orgaõs, State of Rio Janeiro, Brazil.

Type.—In Paris Museum.

One specimen taken in 1902 at an altitude of 500–1,000 meters by E. R. Wagner.

25. POLYCYRTUS (POLYCYRTUS) XANTHOTHORAX Brullé

Mesostenus (*Polycyrtus*) *xantho-thorax* BRULLÉ, Hist. Nat. Inst. Hym., vol. 4, 1846, p. 213, male.—SZEPLIGETI, Ann. Mus. Nat. Hung., vol. 14, 1916, p. 274 (part).

The evaluation of certain characters of color and also of structure in this genus is very difficult with the limited amount of material that I have had for study, but I doubt very much if all the specimens placed under this species by Szepligeti belong here. Certainly he can not be considered consistent in his treatment of color characters when he used the color of the clypeus for separating species in his key and then admits a form with white face as a variety of a black-faced species.

The two specimens that I place here differ from Brullé's description apparently only in the color of the hind trochanters, which in the type are said to be black. Of the two specimens before me one has the trochanters testaceous and the other has them piceous. These specimens are both males from Brazil and both collected by E. R. Wagner, one in Minas Geraës (the type-locality) and the other in the Serra dos Orgãos.

As thus identified this species is very closely related to *medialbus* Cushman, differing, aside from sexual characters, only in having above the frontal horn two rather deep pits separated by a small tubercle and in lacking a median frontal groove; the space between the lower end of the occipital carina and the hypostomal carina is broader; the epomia are slightly developed; the scutellum is more elevated; the propodeal spiracles are distinctly oval; the apophyses are long, slender, and curved; the scutellum is stained with piceous; the tegulae are largely stramineous; and the tergites lack the apical white spots though having the margins reddish. In the male the antennal annulus begins on the eighth flagellar joint.

The female is unknown to me unless it is to be found in the next preceding or the next following species.

26. POLYCYRTUS (POLYCYRTUS) ATRINASUTUS, new species

Female.—Length 9 mm.

This may prove to be the female of *xanthothorax* Brullé though it differs from the males that I have determined as that species in lacking the two pits at the base of the frontal horn though possessing the tubercle, and in having the clypeus entirely and mandibles partly black and the pronotum and propleura largely so. Otherwise in the structural and colorational characters mentioned under *xanthothorax* it agrees with that species and differs from *medialbus* Cushman. From *medialbus* it differs further in having the malar space as long as basal width of mandible, the ocelli smaller; basal joint of flagellum more slender; second tergite distinctly shorter than first and hardly three times as long as broad at base; sheath nearly as long as hind tibia. Clypeus black; mandibles largely black; annulus beginning at base of joint 5; pronotum and propleura largely black; scutellum at apex, postscutellum, and apophyses red, the scutellum stained with piceous; front and middle legs darker, not at all stramineous; tergites without median white spots, apically narrowly reddish.

Type-locality.—Minas Geraës, Brazil.

Type.—In Paris Museum.

One specimen taken at 1,000 meters by E. R. Wagner in 1903.

27. POLYCYRTUS (POLYCYRTUS) COCKERELLAE Viereck

Polycyrtus cockerellae VIERECK, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 593, female.

Female.—Length 13 mm.

Vertex in front view concave; frons with poorly defined scrobes, horn rather small conical; eyes slightly convergent below and comprising nearly two-thirds total width of head; face polished, slightly impressed each side of middle, weakly punctate in impressions; malar space opaque, distinctly shorter than basal width of mandible, weakly constricted; mouth as broad as narrowest width of face; occipital carina convergent above with posterior margin of eye, with only a small notch at its lower end, where it joins the hypostomal carina, latter rather low; temples from above flat, nearly perpendicular to longtitudinal axis of body, little more than a fourth as long as short diameter of eye; diameter of ocellus two-thirds ocell-ocular line and distinctly longer than postocellar line; basal joint of flagellum fully eight times as long as thick. Thorax and propodeum polished, nearly unsculptured; pronotum with anterior lateral carina short but high, epomia strong but not ascending to dorsal margin, humeral margin weakly tumid, lower angle longitudinally striate; prescutum not especially prominent, lateral

lobes flattened; mesopleural furrow foveolate throughout, prepectal furrow only above, humeral angle rugulose, subalar tubercle carinate; propodeum flat in basal middle, carina broadly curved toward front, spiracles large elongate, apophyses rather small, slightly compressed, as thick in middle as at ends, inner calcarium little more than a third as long as basitarsus; areolet small, recurrent strongly antefurcal, nervulus interstitial, postnervulus broken at middle, nervellus nearly four times as long as broad at base and as long as first; sheath as long as hind tibia.

Head black and white; face, except in middle above, clypeus, mandibles, frontal and superior orbits, spot in posterior orbits, and annulus embracing flagellar joints 5–11 white; maxillary palpi stramineous, labial palpi fuscous; pronotum, mesonotum, metanotum, and propodeum basad of carina black; propleura, anterior, lower, and humeral margins of pronotum, apex and sides of scutellum and basal carinae, postscutellum and apophyses white; thorax and propodeum otherwise pale testaceous; front and middle legs testaceous, paler basally and anteriorly, their tarsi largely brown; hind leg testaceous, trochanter and femur very pale below, tibia yellowish, tarsus whitish; wings hyaline, venation brown, stigma paler, tegulae white with apex stramineous; abdomen black above, whitish laterally, first tergite apically, second basally and apically, the gastrocoeli, and other tergites apically, whitish.

Guatemala. Known only from the unique type.

28. POLYCYRTUS (POLYCYRTUS) INQUINATUS, new species

Female.—Length 13 mm.

From *cockerellae*, to which it is rather closely related, it differs as follows: Vertex hardly concave; eyes comprising much less than two-thirds total width of head; malar space subequal to basal width of mandible; cheeks in front view convex; occipital carina very nearly parallel to posterior margin of eye; temples strongly oblique, nearly half as long as short diameter of eye; diameter of ocellus less than two-thirds as long as ocell-ocular line and little longer than the postocellar line; basal joint of flagellum only about six times as long as thick. Epomia longer, causing the tumid humeral welt of pronotum to appear angulate from above; prescutum more elevated; subalar tubercle not carinate; propodeum slightly impressed in basal middle; carina nearly straight, spiracle broadly oval; apophyses longer, more slender and hardly compressed; hind femur more slender; areolet larger, recurrent nearly interstitial, nervulus antefurcal. Second tergite barely three times as long as broad at base; sheath hardly as long as hind tibia.

Posterior orbits white, interrupted behind top of eye; annulus beginning on sixth joint of flagellum; lateral margin of mesoscutum pale reddish; scutellum black at sides; spot below subalar tubercle

piceous; propodeum piceous above to apex, broadly so before apophyses, more narrowly so behind; hind trochanter and femur blackish to piceous; second tergite not white at extreme base.

Male.—Essentially like female.

Type-locality.—Villa Lutecia, near San Ignacio, Missiones, Argentina.

Type.—In Paris Museum.

Allotype.—Cat. No. 42192, U.S.N.M.

One of each sex taken by E. R. Wagner in 1910.

29. POLYCYRTUS (POLYCYRTUS) MEDIOTINCTUS, new species

Female.—Length 13 mm.

Differs from above description of *cockerellae* as follows: Vertex very shallowly concave; frontal horn large conical, eyes nearly parallel within and comprising much less than two-thirds total width of head; face minutely alutaceous, impunctate, slightly swollen next to the eyes; occipital carina nearly parallel with posterior margin of eye, hardly notched at its junction with hypostomal carina; temples from above oblique, about two-fifths as long as short diameter of eye; diameter of ocellus less than two-thirds as long as ocell-ocular line. Pronotum with anterior lateral carina rather low, epomia forming a carinate angle at anterior end of weltlike humeral margin, lower half of posterior margin foveolate; lateral lobes of mesoscutum longitudinally subimpressed; subalar tubercle not carinate; propodeum slightly impressed in basal middle, spiracles large oval, apophyses longer, slender, and slightly curved; nervulus antefurcal, postnervulus broken above middle, nervellus at lower fourth. Second tergite less than three times as long as broad at base.

Lower posterior orbits and cheeks also white; collar black; scutellum white in middle but not at sides; propodeum black basad of carina, piceous beyond, this color fading out beyond apophyses; thorax otherwise paler, nearly stramineous; hind femur piceous throughout; second tergite basally black, gastrocoeli reddish.

Type-locality.—Tegucigalpa, Honduras.

Type.—Cat. No. 42193, U.S.N.M.

Two females collected April 5, 1917, by F. J. Dyer.

30. POLYCYRTUS (POLYCYRTUS) AREOLARIS, new species

Female.—Length 14 mm.

Vertex in front view nearly straight, frons with shallow, poorly defined scrobes, horn stout conical; eyes nearly parallel within, comprising much less than two-thirds total width of head at level of antennae, the inner margin faintly concave arcuate, face polished, minutely alutaceous laterally, longitudinally impressed on each side

of middle, punctate above; malar space a little longer than basal width of mandible, slightly constricted, mouth barely as broad as narrowest width of face, cheeks slightly convex; temples in side view broad, occipital carina weakly convergent above with posterior margin of eye, not prominent below but terminating some distance from hypostomal carina, latter moderately high; temples from above nearly flat, oblique, about a third as long as short diameter of eye; diameter of an ocellus about two-thirds as long as ocell-ocular line. Thorax polished; pronotum striate along posterior margin, the striae reaching into the scrobe in middle, anteriar lateral carina moderately high, epomia strong, angulating the anterior end of the swollen humeral margin; prescutum moderately high, lateral lobes with weak longitudinal sulcus; scutellum rather low; mesopleural furrow finely foveolate, prepectal furrow foveolate only above, subalar tubercle not carinate; metapleurum with a few small punctures; propodeum with a narrow basal area defined laterally by carinae, transverse carina narrowly arched forward medially, spiracle large, elongate ovate, apophyses rather short stout conical, much nearer to carina than to apex; hind femur distinctly less than twice as thick in middle as at apex; inner calcarium hardly two-fifths as long as basitarsus; areolet large, recurrent and nervulus antefurcal; postnervulus broken just above middle, nervellus at lower third. Abdomen broad, second tergite hardly two and a half times as long as broad, much shorter than first; sheath distinctly longer than hind tibia.

Head black and white; face, clypeus, except apical margin, orbits, temples, cheeks, spot at base of mandible, maxillary palpi, labial palpi basally, annulus embracing flagellar joints 6–11 and apical half of 5, white; prothorax, mesonotum, and metanotum black, propleura, anterior-lateral and humeral margins of pronotum, two lines on disk of mesoscutum, apex of scutellum and the carinae, apex of postscutellum, white; thorax otherwise and propodeum largely ferruginous; upper margin of mesopleurum black; subalar tubercle, upper division of metapleurum partly, and apices of apophyses white; median stripe on propodeum and a small spot at upper edge of spiracle piceous black; legs ferruginous, hind tibia yellowish, tarsus whitish; wings yellowish hyaline, venation brown, stigma paler, tegulae white; abdomen black and white, the tergites broadly white apically and laterally, the second wtih a transverse subtriangular white spot medially near base.

Male.—Essentially like female. Annulus on flagellar joints 8–16.

Type-locality.—Rio Trinidad, Panama.

Type.—Cat. No. 42194, U.S.N.M.

Two specimens, both collected by August Busck, the type female on March 20 and the allotype on March 30, 1912.

31. POLYCYRTUS (POLYCYRTUS) CIRCUMFLUENS, new species

Female.—Length 12 mm.

Closely related to *areolaris* Cushman, from the foregoing description of which it differs only as follows: Eyes more strongly convergent below; propodeum weakly longitudinally impressed, without a defined basal area, carina nearly straight; abdomen more slender, second tergite fully three times as long as broad at base.

Propodeum without piceous markings; second tergite with an elongate oval subbasal white spot.

Male.—Essentially like female. Annulus embracing flagellar joints 8–16 (broken at this point).

Type-locality.—Cayenne, French Guiana.

Type.—Female in Paris Museum.

Allotype.—Cat. No. 42195, U.S.N.M.

One of each sex collected by R. Benoist in 1914.

32. POLYCYRTUS (POLYCYRTUS) MANNI, new species

Female.—Length 12 mm.

Vertex in front view shallowly concave; frons with scrobes poorly defined, horn stout conical; eyes rather weakly convergent below, inner margins faintly concavely arcuate; face impressed on each side of middle, punctate above; malar space distinctly shorter than basal width of mandible, not constricted, mouth fully as broad as narrowest width of face; temples in side view rather narrow, occipital carina nearly parallel with posterior margin of eye, reaching the hypostomal carina and without a distinct notch next to hypostomal carina; temples from above oblique, flat, a little more than a fourth as long as short dismeter of eye; diameter of ocellus two-thirds as long as ocell-ocular line and only a little longer than post-ocellar line; basal joint of flagellum hardly eight times as long as thick. Thorax polished; pronotum longitudinally striate in middle of posterior edge; anterior lateral carina prominent, epomia strong, angulating the weltlike humeral margin; prescutum rather high; lateral lobes subsulcate; mesopleurum rugulose in upper anterior angle, subalar tubercle not carinate, both prepectal and mesopleural furrows foveolate; metapleurum coarsely punctate in middle; propodeum weakly impressed in basal middle, with a narrow median groove from carina backward to a point between the apophyses, carina arched sharply forward medially, spiracles broadly oval, apophyses moderately long, slender and weakly curved, much nearer to carina than to apex; hind femur hardly twice as thick in middle as at apex, inner calcarium two-fifths as long as basitarsus; areolet large, recurrent and nervulus antefurcal, postnervulus broken slightly above middle, nervellus at lower fourth. Abdomen stout, second

tergite two and a half times as long as broad at base and distinctly shorter than first, sheath as long as hind tibia.

Head black with the following white: Face, clypeus, orbits except narrow interruption in malar space (the posterior orbits narrowly so), maxillary palpi and bases of labial palpi, and annulus embracing flagellar joints 5–11 and most of 4; thorax black anteriorly and dorsally, ferruginous laterally and ventrally as is also the propodeum; ventral extremities of propleura pale ferruginous and white with apex stramineous; margins and small spot on lower anterior margin of pronotum, two discal lines on mesoscutum apices of scutellum and postscutellum, and scutellar carinae white; upper portion of mesopleurum black with subalar tubercle white; upper division of metapleurum partly whitish; propodeum with a longitudinal dash of black crossing the carina, apophyses whitish apically; legs ferruginous, hind tibia yellowish, tarsi whitish; wings hyaline, venation brown, stigma pale in middle, tegulae white; abdomen black and white with petiole red and apical margin of first tergite and apical and lateral margins of others white.

Type-locality.—Rurrenabaque, Rio Beni, Bolivia.

Type.—Cat. No. 42196, U.S.N.M.

One specimen received from the Mulford Biological Exploration and taken in November, 1921, by W. M. Mann.

33. POLYCYRTUS (POLYCYRTUS) CONFUSUS, new species

Polycyrtus copiosus CRESSON, Proc. Acad. Nat. Sci. Phila., 1873, p. 146 (part).

In describing *copiosus* Cresson confused at least three species, of which the present species is one. Paratype 771.8, Acad. Nat. Sci. Phila., and cotype No. 13247, U. S. Nat. Mus., constitute the type series of *confusus*. These two specimens are before me, the former by loan from the Academy of Natural Sciences of Philadelphia through the kindness of Mr. E. T. Cresson, jr. The abdomens of both specimens have been damaged by dermestids, but most of the dorsal surface remains.

This species differs in many respects from *copiosus*, but most strikingly in the abrupt, prominent termination of the occipital carina some distance away from the hypostomal carina, in the short straight apophyses, and in the short malar space.

Female.—Length about 10 mm.

Vertex in front view straight; frons with poorly defined scrobes but with a median elevation defined by deep, narrow furrows converging toward the horn, the latter stout conical; eyes weakly convergent below, comprising much less than two-thirds total width of head; face polished impunctate, longitudinally impressed each

side of middle; malar space hardly as long as basal width of mandible, constricted, mouth hardly as broad as narrowest width of face; occipital carina in side view strongly convergent above with posterior margin of eye, prominent below and separated from hypostomal carina by a rather deep furrow, hypostomal carina low; temples from above weakly oblique, flat, about a third as long as short diameter of eye; diameter of ocellus nearly as long as ocell-ocular line and nearly twice postocellar line; first joint of flagellum about seven times as long as thick. Thorax polished, almost without sculpture; anterior lateral carina of pronotum not especially high, epomia short but distinct; prescutum convex, rather low anteriorly, lateral lobes slightly flattened; scutellum rather low, prepectal carina obsolete from shortly above notauli; mesopleural furrow foveolate; propodeum not impresed in basal middle, basal carina nearly straight, spiracle broadly oval, apophyses of moderate length, straight, about midway between carina and apex; hind femur distinctly less than twice as thick in middle as at apex, inner calcarium half as long as basitarsus; areolet small, short, recurrent not far before apex; nervulus interstitial (type) or slightly antefurcal (paratype); postnervulus broken above middle, nervellus broken not far below middle. Abdomen rather stout, second tergite three times as long as broad at base, distinctly shorter than first; tergites beyond second clothed with conspicuous blackish hairs.

Head black, face, clypeus, mouth parts, apex of frontal horn, and orbits (broadly on front, narrowly behind eyes) white; lower cheeks black; annulus embracing flagellar joints 5–11 and apex of 4; propleura whitish; pronotum black with broad anterior-lateral and humeral margins whitish; mesoscutum immaculate black; scutellum and carinae and postscutellum whitish, lateral areas black, apophyses whitish; thorax otherwise and propodeum testaceous; legs testaceous, coxae stramineous, hind tibia and tarsus pale, front and middle tarsi fuscous; wings pale yellowish hyaline, stigma pale, veins black; abdomen largely whitish, petiole pale testaceous, tergite 2 broadly and 3 and 4 narrowly piceous at base.

Type-locality.—Orizaba, Mexico.

Type.—Cat. No. 13247, U.S.N.M.

Paratype.—No. 771.8, Acad. Nat. Sci. Phila.

Two specimens from the type series of *Polycyrtus copiosus* Cresson.

34. POLYCYRTUS COPIOSUS Cresson

Polycyrtus copiosus Cresson, Proc. Acad. Nat. Sci. Phila., 1873, p. 146, female, male (part).

Finding that a cotype of this species deposited in the United States National Museum disagreed in some respects with the original description I asked Miss Grace Sandhouse on a visit to the Academy

of Natural Sciences of Philadelphia to examine the type series. Miss Sandhouse reported that the lectotype and paratypes 2–7 and 11–12 are one species and agree with the description, while paratypes 8–10 disagree with the description.

Through the kindness of Mr. E. T. Cresson, jr., I have borrowed the three discordant paratypes and find that not only are they not *copiosus* but that only No. 8, a female, is the same as the National Museum specimen, while Nos. 9 and 10, both males, represent a third species, which belongs to the subgenus *Cryptanuridimorpha*. The two females I have described above as *Polycyrtus* (*Polycyrtus*) *confusus*. Because of the lack of the female I do not describe the third species.

P. copiosus differs from the foregoing description of *confusus* as follows:

Female.—Vertex in front view slightly concave; frons evently concave, without median elevation or grooves, but with a small tubercle at base of horn; eyes more strongly convergent below; malar space distinctly longer than basal width of mandible, strongly constricted, mouth distinctly narrower than narrowest width of face; occipital carina weakly convergent above with posterior margin of eye, weakly prominent below and separated from hypostomal carina by a shallow furrow; diameter of lateral ocellus barely two-thirds as long as ocell-ocular line and not nearly twice postocellar line; first joint of flagellum nearly ten times as long as thick. Scutellum high; prepectal carina complete; metapleurum obliquely rugose; propodeal spiracles narrowly oval, apophyses very long, slender and curved, much nearer to carina than to apex; inner hind calcarium less than half as long as basitarsus; areolet of normal size and form with recurrent strongly antefurcal.

Face white except medially and in clypeal groove, where it is brown; posterior orbits with a large, elongate white spot; scutellum discally black.

Male.—Face entirely white; annulus beginning on eighth flagellar joint; all tergites beyond first blackish at base. Otherwise much like female.

The above comparison with *confusus* is based on one specimen of each sex from Mexico in the United States National Museum, the female a metatype.

35. POLYCYRTUS (POLYCYRTUS) COLLICULATUS, new species

Distinct from all other species known to me in the arrangement of color on the thorax and the form of the propodeum.

Female.—Length 14 mm.

Vertex and frons concave, horn large, conical and without either tubercle or ridges above its base; eyes slightly convergent below, com-

prising distinctly less than two-thirds total width of head; face shallowly impressed each side of middle; clypeus in profile only moderately prominent; malar space slightly longer than basal width of mandible; occipital carina parallel with posterior margin of eye, prominent below and separated by a rather deep narrow notch from hypostomal carina, latter moderately high; temples oblique, flat, somewhat less than half as broad as short diameter of eye; diameter of lateral ocellus three-fourths ocell-ocular line and more than twice postocellar line; flagellum slender, basal joint about eight times as long as thick at apex. Thorax polished, practically without sculpture; pronotum strongly tumid on dorsal margin, lateral anterior margin with a high carina, epomia absent; mesoscutal lobes high, the lateral lobes slightly flattened; scutellum moderately high, compressed; mesopleural furrow distinctly, prepectal furrow not, foveolate, subalar tubercle low, smooth, not carinate; metapleurum very faintly roughened along middle; propodeum polished with a few obscure arcuate carinae on apical slope, basal middle deeply impressed, with a low rounded elevation on each side, spiracles rather small, narrowly oval, basal carina straight medially, apophyses rather long, conical, curved, placed distinctly closer to carina than to apex; hind femur very slender, only slightly thickened in middle; inner calcarium barely more than a third as long as basitarsus; areolet of normal size and form with recurrent interstitial, nervulus antefurcal, postnervulus broken slightly below middle, nervellus broken at lower third. Abdomen slender, rather strongly compressed at apex, inconspicuously hairy; postpetiole hardly twice as broad as petiole; second tergite about four times as long as broad at base and very nearly as long as first; sheath more than twice as long as first tergite and somewhat longer than hind tibia.

Head black and white, face, clypeus except apex, orbits except an interruption behind eyes above, mandibles, palpi, and annulus beginning at base of sixth flagellar joint (only eight joints present) white; thorax black, the following yellowish white: Upper and lower anterior margins of pronotum, propleura at apex, two narrow lines on pronotum, scutellar carinae and apices of scutellum and postscutellum, mesopleurum largely (the anterior and posterior margins and streaks in the impressions which divide the yellow nearly into three separate spots are black), an elongate spot at side of sternum, upper and lower divisions of metapleurum (furrow black), tops of the basal elevations on propodeum, apophyses and a stripe extending from each apophysis to posterior margin and a narrow, oblique lateral line from base of apophysis; mesosternum and metasternum ferruginous; coxae ferruginous, the anterior pair darker with a white stripe anteriorly, middle coxa faintly whitish above; front trochanter

and femur white anteriorly, piceous behind, the femur almost black, tibia whitish; middle leg like front leg except that trochanter and femur are red in front, hind femur reddish piceous, darker behind, tibia and tarsus whitish; wings pale yellowish hyaline, venation blackish; abdomen black, lateral margins of all except last tergite, a median ventral stripe on petiole, and entire venter white, gastrocoeli pale red.

Type-locality.—Serra dos Orgaõs, Province of Rio Janeiro, Brazil, 800–1,000 meters.

Type.—In Paris Museum.

One specimen taken by E. R. Wagner in 1902.

36. POLYCYRTUS (POLYCYRTUS) MACER Cresson

Polycyrtus macer CRESSON, Proc. Acad, Nat. Sci. Phila., 1873, p. 144, female, male.

Known to me only in the male, a cotype of that sex from Mexico being in the United States National Museum. This specimen is the basis of the following description.

Male.—Vertex in front view weakly concave; frons with scrobes shallow, horn short, stout conical; eyes nearly parallel within; face polished, finely punctuate above, longitudinally impressed on each side of middle; malar space hardly as long as basal width of mandible, constricted, mouth barely as broad as narrowest width of face; temples in side view rather narrow, occipital carina nearly parallel with posterior margin of eye, low throughout, recurving below to meet the hypostomal carina at about the middle, latter low; temples from above flat, weakly oblique, about a third as long as short diameter of eye; diameter of ocellus three-fourths as long as ocell-ocular line and about a half longer than postocellar line. Thorax polished, without sculpture; pronotum with anterior lateral carina low, epomia distinct but short; prescutum low, lateral lobes flattened above; scutellum moderately high; mesopleurum with the furrows weakly foveolate, subalar tubercle not carinate; propodeum not impressed medially, carina nearly straight, spiracle elongate, apophyses low, carinate, the carinae continuing down to posterior lateral corners of propodeum; hind femur nearly twice as thick in middle as at apex, inner calcarium two-fifths as long as basitarsus; areolet rather small, narrow, recurrent and nervulus nearly interstitial, postnervulus broken at middle, nervellus at lower fourth. Abdomen slender, second tergite fully five times as long as broad at base.

Head black and white, face except short median line above, clypeus except apical margin and lateral sutures, mandibles, orbits

(nearly interrupted behind top of eye and in malar space), and annulus begining on flagellar joint 7 white; thorax black and white or whitish, propleura, anterior laterial and humeral margins of protonum, scutellum and postscutellum apically and the scutellar carinae, tegulae, mesopleurum except along sutures, sternum, metapleurum except suture and a small spot at apex, and propodeum white, the last with basal and lateral sutures and a narrow mediam stripe crossed on carina by a narrow line, black; legs testaceous, coxae above whitish, hind trochanters tinged with piceous, tibia yellowish, infuscate at extreme base, tarsus whitish, front and middle tarsi fuscous; wings yellowish hyaline, stigma pale, veins brown; abdomen white with piceous black markings as follows: disk of postscutellum, venter of petiole, extreme base of second tergite and a discal spot on same broad posteriorly and bifurcate anteriorly, and other tergites basally and medially.

37. POLYCYRTUS (POLYCYRTUS) DUPLICATUS, new species

Apparently very closely allied to *mancus* and possibly synonymous with that species, the type of which I have not seen. It differs from a male cotype of *mancus* in the United States National Museum in the form of the occipital carina in addition to several differences in color. There appears to be some justification for doubt that the above mentioned cotype is conspecific with the female type of *mancus*.

Female.—Length 11 mm.

Vertex in front view nearly flat; frons with scrobes shallow, horn rather stout conical; eyes weakly convergent below, comprising considerably less than two-thirds total width of head; face polished, minutely alutaceous laterally above and distinctly punctate medially above, with a rather deep longitudinal impression on each side of middle; malar space as long as basal width of mandible, constricted, mouth hardly as broad as narrowest width of face; temples in side view rather narrow, occipital carina convergent above with posterior margin of eye, rather prominent below where it recurves and does not reach the hypostomal carina, from which it is separated by a shallow groove; temples from above weakly oblique, flat, hardly a third as long as short diameter of eye; diameter of ocellus two-thirds as long as ocellocular line; basal joint of flagellum nearly eight times as long as thick. Thorax polished, mesopleurum and metapleurum sparsely punctate in middle; pronotum with anterior lateral margin subangulate, the carina moderately high, epomia strong, angulating the anterior end of the swollen humeral margin, groove along posterior margin foveolate, the foveolation in middle prolonged into striations extending into the scrobe; prescutum rather high, lateral lobes faintly sub-

sulcate; scutellum not high; prepectal suture foveolate only at its upper end, mesopleural suture strongly foveolate, subalar tubercle not carinate; propodeum more than a half longer than broad, weakly impressed in basal middle, the impression continued behind the carina as a narrow, shallow groove, carina narrowly subangulate in middle, spiracles oval, apophyses rather long and slender, much nearer to carina than to apex; hind femur little more than a half thicker in middle than at apex, inner calcarium two-fifths as long as basitarsus, areolet rather broad, recurrent and nervulus antefurcal, postnervulus broken above middle, nervellus above lower third. Abdomen minutely alutaceous beyond second tergite, stout, second tergite hardly two and a half times as long as broad at base and distinctly shorter than first; sheath as long as hind tibia.

Black and yellow with the following parts yellow: Face, clypeus except apical margin, broad orbital ring, spot at base of mandible, palpi, annulus on flagellar joints 4–11; propleura, anterior-lateral and humeral margins of pronotum, two short discal lines on mesoscutum, scutellum and its carinae, postscutellum, mesopleurum except just below wings, sternum, metapleurum; propodeum except basal suture and median and lateral longitudinal lines, the former widened on carina, the latter extending backward from spiracles; broad lateral and apical margin of tergites and a transversely quadrilateral subbasal spot on second tergite; legs stramineous with dorsal sides of femora ferruginous, the hind femur with a yellow median dorsal line, hind tibia yellowish, tarsus whitish; wings hyaline, veins brown, stigma pale.

Type-locality.—Rio Trinidad, Panama.

Type.—Cat. No. 42197, U.S.N.M.

One specimen taken March 20, 1912, by August Busck.

38. POLYCYRTUS (POLYCYRTUS) TRIANGULARIS, new species

Closely related to *duplicatus* Cushman, from the above description of which it differs as follows:

Female.—Length 12 mm.

Malar space not constricted, mouth fully as broad as narrowest width of face; temples in side view broader, occipital carina nearly parallel with posterior margin of eye, of same form but a little more prominent below and separated from hypostomal carina by a deep groove; temples from above weakly concave and fully a third as long as short diameter of eye. Propodeum less than a half longer than broad, apophyses stout; inner hind calcarium barely a third as long as basitarsus.

Mandibles entirely black; median black stripe of propodeum broad, the transverse mark on carina confluent with lateral stripes; subbasal

white spot of second tergite triangular; hind and middle coxae with piceous stains dorsally.

Type-locality.—Rio Trinidad, Panama.

Type.—Cat. No. 42198, U.S.N.M.

One specimen taken March 20, 1912, by August Busck.

39. POLYCYRTUS (POLYCYRTUS) MAJOR Cresson

Related to *duplicatus* but larger (female about 14 mm.) and differing from the above description of *duplicatus* further as follows: Malar space not constricted, mouth as broad as narrowest width of face; occipital carina weakly convergent above with posterior margin of eye, not reaching hypostomal carina but not recurving and very low at lower end. Propodeum not more than a half longer than broad, more or less punctate or punctate-rugose medially behind carina and laterally; apophyses very long, slender, curved; metapleurum strongly punctate-rugose; hind inner calcarium little more than a third as long as basitarsus.

Mandibles yellow except apex and lower margin; annulus on flagellar joints 5–10; scutellum black with only apex and carinae yellow; median stripe of propodeum broader, the transverse mark on carina confluent with lateral stripes; subbasal yellow spot transversely subtriangular and confluent with lateral yellow margin; coxae white with a black stripe dorsally, femora and trochanters piceous above, tibiae more or less infuscate above and toward base; wings yellowish or a little infuscate; stigma largely fuscous.

Male.—Annulus on flagellar joints 8 or 9 to 14 or 15; propodeum less distinctly sculptured, apophyses shorter and hardly curved; subbasal yellow spot of second tergite not angulate posteriorly; legs, especially middle tibiae, darker.

The above notes are based on two females and three males as follows: A metatype female from Mexico; one female from Rio Trinidad, Panama (March 30, 1912, August Busck); one male from San Rafael, Jicoltepec, Mexico; and two males collected in Mexico by Sallé. The last two were received from the Paris Museum, to which one is returned.

40. POLYCYRTUS (POLYCYRTUS) SEMIALBUS (Cresson) (new combination)

Mesostenus semialbus Cresson, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 30, female, male.

41. POLYCYRTUS (POLYCYRTUS) MONTEZUMA Cameron

Polycyrtus montezuma Cameron, Biol. Cent. Amer., pt. 42, 1885, p. 234, pl. 10, fig. 6, male.

There is nothing in the descriptions of these two species to distinguish them. Before me are four female specimens from Mexico that

appear to be *montezuma* and one female from Cuba that is almost certainly *semialbus*. Between the Mexican and Cuban specimens there are only very minor differences, which, however, so far as the scanty material goes, appear to be constant, although perhaps not of specific significance.

In the specimens that I am considering *montezuma* the eyes are a little more distinctly convergent below; the cheeks in side view a little broader; and the pale markings more strongly tinted with yellow than in *semialbus*.

As here identified the two species are very much like *major* Cresson, differing principally as follows: Frons with a more or less well-defined tubercle above base of horn; occipital carina in side view parallel with posterior margin of eye, complete to hypostomal carina: temples from above slightly convex; metapleurum and propodeum more strongly sculptured, apophyses stouter and straight.

Propodeum without a transverse black line on carina; median black spot on second tergite not emarginate anteriorly but narrowly truncate or rounded; femora ferruginous, at most a little darker above; tibiae not infuscate.

The specimens of *montezuma* in the National Collection are from the C. F. Baker collection and are labeled simply "Mex."

The one specimen of *semialbus* was taken by S. C. Bruner on November 6, 1922, at Santiago de las Vegas, Cuba.

42. POLYCYRTUS (POLYCYRTUS) LITURATUS Brullé

Figure 3

Mesostenus (*Polycyrtus*) *lituratus* BRULLÉ, Hist. Nat. Ins. Hym., vol. 4, 1846, p. 208, female, male.

Mesostenus lituratus CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 28, female, male.

The specimens that I have identified as this species agree perfectly with Brullé's description except that the dark color of the head and thorax is a dark brown or piceous rather than true black. In this respect it is very distinct from the two following species in which the color pattern is very similar.

Female.—Length 13 mm.

Vertex in front view flat; frons with rather deep scrobes and with a high median ridge above base of horn, latter stout conical; eyes weakly convergent below, comprising much less than two-thirds total width of head; inner and superior orbits minutely alutaceous; face longitudinally impressed each side of middle, medially coarsely punctate; occipital carina in side view slightly convergent above with posterior margin of eye, complete and strong to hypostomal carina, latter very high throughout and leaning toward its fellow (fig. 3);

malar space hardly as long as basal width of mandible, weakly constricted; mouth as broad as narrowest width of face; temples from above nearly flat, oblique, about a third as long as short diameter of eye; diameter of lateral ocellus fully three-fourths as long as ocell-ocular line; basal joint of flagellum little more than six times as long as thick at apex. Thorax polished; anterior lateral margin of pronotum subangulate, carina moderately high, epomia strong, angulating the swollen humeral margin, groove along posterior margin foveolate, the foveolation in middle prolonged into striations extending into the scrobe; prescutum moderately high, lateral lobes flattened above; scutellum not elevated; mesopleurum and sternum with scattered punctures, prepectal carina incomplete above, the suture not foveolate; metapleurum very coarsely diagonally rugose, the upper division sparsely punctate; propodeum rugose behind carina, smooth with a few large punctures before, with a more or less nearly complete narrow median longitudinal furrow, carina nearly straight, spiracles large oval, apophyses long, stout, apically compressed, closer to carina than to apex, hind femur one and a half times as thick in middle as at apex, inner calcarium a little more than a third as long as basitarsus; areolet short and broad, recurrent and nervulus antefurcal, postnervulus broken at middle, nervellus above lower third. Abdomen very minutely alutaceous, stout, second tergite not or barely twice as long as broad at base, much shorter than first; sheath very nearly as long as hind tibia.

Head and thorax dark brownish piceous with the following markings whitish: Face, clypeus, very broad complete orbital ring, apex of frontal horn, bases of palpi, annulus on flagellar joints 5–10; propleura, broad anterior lateral and humeral margins of pronotum, nearly the entire length of inner margin of lateral lobes of mesoscutum, mesopleurum, and sternum, except a streak along posterior margin continuing above into the impression below subalar tubercle, and reddish stains anteriorly on prepectus and in sternauli; apex of scutellum and the carinae, these two markings usually confluent; postscutellum; metapleurum except along suture dividing upper and lower divisions and a spot near apex of lower division; propodeum white with basal suture, median and two lateral stripes, and a broad transverse band just behind carina and broadly confluent with lateral stripes, piceous; this leaves two rounded white spots basad of carina and confluent with the white of the lower division of the metapleurum and two larger elongate marks on the apical slope embracing the apophyses; legs ferruginous, all tarsi fuscous at least apically, coxae whitish above, hind coxa with a piceous streak in middle; wings yellowish hyaline, veins brown, stigma paler. Abdomen black with following whitish markings; Apex and

sides of first segment (black above and below); narrow lateral and broad apical margins of other tergites, and two large subreniform subbasal spots on second tergite.

Male.—Essentially like female. Annulus on flagellar joints 8 or 9 to 13 or 14; temples convex; malar space distinctly shorter than basal width of mandible; prescutum usually more or less white laterally; propodeum less strongly sculptured; abdomen more slender.

The above description is based on three of each sex, all from Cuba. Four of these, received from the Paris Museum, were collected at Havana in 1908 by P. Serre. From this series two males are retained for the National Collection and a pair returned to the Paris Museum. The other two females are labelled "Cuba, M. S. Roig," and are numbered 284 and 292.

43. POLYCYRTUS (POLYCYRTUS) COLLINUS Cameron

Polycyrtus collinus CAMERON, Biol. Cent. Amer., Hym., vol. 1, p. 231, pl. 10, fig. 2, female.

Two specimens that I have determined as this species are before me, a female taken at LaCeiba, Honduras, October 18, 1916, by F. J. Dyer, and a male taken at Gatun, Panama Canal Zone, August 20, 1923, by R. C. Shannon.

Female.—Differs from above description of *lituratus* as follows: Eyes very nearly parallel within; hypostomal carina very low behind occipital carina and erect; temples from above slightly convex; ocelli a little smaller; metapleurum more finely rugose; propodeum only obsoletely rugose apically, sparsely punctate otherwise. apophyses rather short; abdomen a little more slender.

Head and thorax with essentially the same color pattern as *lituratus* but black instead of piceous; frontal horn entirely black; orbital ring narrowly interrupted behind top of eye; discal marks on mesoscutum short; transverse black band of propodeum abruptly narrowed above apophyses and narrowly confluent with lateral stripes; legs white with a black dorsal streak from base of coxa to apex of tibia and in front and middle legs to apex of basitarsus, other joints of front and middle tarsi black, hind tarsus white; black of dorsum of first tergite reduced to a narrow, somewhat anchor-shaped mark with the tips of its flukes on the spiracles; black of second tergite nearly divided into two by narrow extensions of white from the sides

Male.—Differs from female in much the same way as does the male of *lituratus* from its female. The propodeum is practically unsculptured and the sculpture of the metapleurum is reduced to coarse punctation. The hind tibia is dark above only at base.

44. POLYCYRTUS (POLYCYRTUS) NEGLECTUS Cushman

Polycyrtus neglectus CUSHMAN, Proc. U. S. Nat. Mus., vol. 67, art. 23, 1926, p. 5.

Much smaller than either *lituratus* or *collinus* but very similar in structure and color, especially to the latter. The pleura are distinctly reddish and lack the black markings along the posterior margin and in sternauli and prepectus; the legs are ferruginous without black markings; the orbital white ring is sometimes complete and sometimes interrupted; the arrangement of color on dorsum of thorax, propodeum, and abdomen is as in *collinus;* the metapleurum and propodeum vary from distinctly rugose to almost without sculpture.

In addition to the large type series I have examined five more females and six more males from Connecticut, Pennsylvania, and the environs of Washington, D. C.

45. POLYCYRTUS (POLYCYRTUS) RUFIPLEURIS Szepligeti

Figures 7, 8

Polycyrtus rufipleuris SZEPLIGETI, Ann. Mus. Nat. Hung., vol. 14, 1916, p. 272, female.

As I have identified this species it differs from all others known to me in its convex but not prominent clypeus (fig. 7); the entire lack of a carina along the anterior lateral margin of pronotum; low, broad, uncompressed scutellum; rounded and noncarinate tuberculiform apophyses (at least in male); and short, thick, strongly decurved first abdominal segment with spiracles only about three-fifths of the distance from base to apex (fig. 8). The species is known to me only from a single male specimen in the Paris Museum and taken at an altitude of 1,000 meters in the Serra des Orgaõs, Province of Rio Janeiro, Brazil, by E. R. Wagner.

Male.—Temples from above strongly oblique, slightly convex, nearly half as long as short diameter of eye; frons with shallow scrobes, horn short, stout conical; vertex in front view slightly convex; eyes weakly convergent below, comprising much less than two-thirds total width of head; face minutely punctate and very weakly impressed on each side of middle; clypeus very sparsely punctate, convex, not elevated, rounded at apex; malar space much shorter than basal width of mandible, cheeks in front view convex, mouth broader than narrowest width of face; temples in side view broad, occipital carina parallel with posterior margin of eye, subprominent below, recurved and joining hypostomal carina behind middle, latter low. Thorax polished; pronotum without either anterior lateral carinae or epomia and with its anterior lateral

margin entire; prescutum moderately high, lateral lobes slightly flattened; scutellum low, convex, broad, not at all compressed; mesopleurum with subalar tubercle noncarinate, prepectal carina incomplete above, the suture not foveolate, sternauli weak anteriorly, wanting posteriorly; metapleurum obscurely punctate in middle, very strongly convex; propodeum strongly convex, carina straight, spiracle oblong, apophyses low tuberculiform, much closer to apex than to carina; hind femur twice as thick in middle as at apex, inner calcarium barely a third as long as basitarsus; areolet of normal form and size, recurrent weakly antefurcal, nervulus strongly antefurcal, postnervulus broken distinctly below middle, nervellus at lower third. Abdomen polished; first segment short, stout, strongly decurved, spiracles at apical two-fifths; second tergite hardly three times as long as broad at base.

Head black with the following white: face, clypeus, mandibles, broad orbital line complete except for narrow interruption in malar space, maxillary palpi and annulus beginning on sixth flagellar joint; maxillary palpi fuscous; thorax black with mesopleurum largely, sternum, metapleurum, and propodeum ferruginous and with the following white markings: lateral margin of propleura, narrow anterior lateral and broad humeral margins of pronotum, two long discal lines on mesoscutum, scutellum and its carinae entirely and the lateral areas partly, postscutellum, subalar tubercle, a large spot in upper posterior portion of mesopleurum and a smaller one on anterior margin and the apophyses; legs ferruginous, tibiae and tarsi yellow; wings hyaline, faintly yellowish, venation black; abdomen ferruginous.

46. POLYCYRTUS (POLYCYRTUS) INFRACTUS, new species

Unique among the species known to me in its unbroken nervellus, in the single median white spot on mesoscutum, and in the form of the occipital carina.

Female.—Length 7 mm.

Temples from above oblique, convex, a little less than a third as long as short margin of eye, frons with scrobes obsolete, horn short stout conical; eyes weakly convergent below, comprising disinctly less than two-thirds total width of head; face narrowly impressed each side of middle; clypeus rather weakly prominent; malar space as long as basal width of mandible, slightly constricted, mouth hardly as broad as narrowest width of face; occipital carina in side view strongly convergent above with posterior margin of eye, very high and thin below, joining the almost equally high hypostomal carina, the two carinae and the somewhat hollowed cheek forming a deep cavity. Thorax polished; pronotum with anterior

lateral carina moderately high, epomia absent, humeral margins roundly prominent anteriorly; prescutum low, lateral lobes flattened, notauli meeting far before scutellum; scutellum convex, broad, not compressed; subalar tubercle obsolete; mesopleural furrows foveolate; metapleurum practically without sculpture; propodeum polished, more or less longitudinally striate in apical middle, carina straight, spiracles small, oval, pleural carina distinct, apophyses small, slender, a little closer to carina than to apex; hind femur twice as thick in middle as at apex, inner calcarium two-fifths as long as basitarsus; areolet very small, nearly as broad as long with recurrent not far behind middle, nervulus interstitial, postnervulus broken at middle, nervellus curved, reclivous, unbroken, discoidella entirely wanting. Abdomen polished; second tergite three times as long as broad at base, shorter than first; sheath much shorter than hind tibia.

Head and thorax black and white, abdomen and legs ferruginous; white as follows: Face, clypeus, mandibles, palpi, broad entire orbital ring, scape below, frontal horn, annulus embracing flagellar joints 6–10 and portions of 5 and 11; propleura, broad anterior lateral and humeral margins of pronotum, the two confluent, mesopleurum except around margins, sternum (tinged with reddish); round median spot on mesoscutum, scutellum and its carinae, postscutellum, both upper and lower divisions of metapleurum; and propodeum (black basad of carina, along pleural carinae, and a narrow median stripe as far back as apophyses); front coxae whitish; wing hyaline, veins brown, stigma pale.

Type-locality.—Alhajuela, Panama.

Type.—Cat. No. 42199, U.S.N.M.

One specimen taken April 5, 1911, by August Busck.

47. POLYCYRTUS (POLYCYRTUS) BULBOSUS, new species

Figure 6

Very distinct in the form of the frontal horn and the structure of the propodeum.

Female.—Length 9 mm.

Vertex in front view slightly convex; frons with shallow scrobes, horn very large, bulbous, with a very deep pit at its base above (fig. 6); eyes weakly convergent below, comprising much less than two-thirds total width of head; face minutely punctate, weakly impressed on each side of middle; clypeus rather prominently elevated; malar space as long as basal width of mandible, in front view slightly convex, mouth as broad as narrowest width of face; occipital carina in side view convergent above with posterior margin of eye, fading

out below and not reaching the rather low hypostomal carina; temples from above oblique, weakly convex, about a third as long as short diameter of eye. Thorax polished; anterior lateral margin of pronotum with a rounded elevation over the top of which runs the moderately strong carina, epomia wanting; mesoscutum (badly broken by pin) apparently with prescutum low and lateral lobes flattened; scutellum not elevated and hardly compressed; mesopleurum with weak scattered punctures, subalar tubercle not carinate, prepectal carina complete, the furrow foveolate above; lower division of metapleurum coarsely rugose punctate, upper division coarsely and sparsely punctate; propodeum smooth before carina, coarsely rugose behind, medially impressed basally, the impression bounded laterally by carinae, basal carina straight medially, spiracles nearly circular, pleural carina distinct, apophyses rounded tuberculiform, a little closer to carina than to apex; hind femur twice as thick in middle as at apex, inner calcarium two-fifths as long as basitarsus; areolet small, broad, recurrent not far behind middle, nervulus antefurcal, postnervulus and nervellus broken about at middle. Abdomen polished; first segment stout with spiracles at apical two-fifths, second tergite three times as long as broad at base and as long as first; sheath much shorter than hind tibia.

Head black and white with the following white: Face, clypeus, mouth parts, broad, complete orbits, frontal horn, scape at apex below, and annulus on flagellar joints 5–11; pronotum and mesoscutum and lateral areas of scutellum black, anterior and humeral margins of pronotum, scutellum and its carinae, and tegulae white; thorax otherwise ferruginous with subalar tubercle, a poorly defined spot before middle coxa, and the apophyses whitish; legs ferruginous, coxae whitish above, front and middle tarsi fuscous, hind tarsi yellow; wings yellow hyaline, veins brown, stigma pale; abdomen ferruginous.

Type-locality.—Mexico.

Type.—Cat. No. 42200, U.S.N.M.

One specimen from the C. F. Baker collection.

48. POLYCYRTUS (POLYCYRTUS) CARINISPINIS, new species

Figure 5

Unique in the form of the propodeum, especially of the apophyses.

Female.—Length 10 mm.

Vertex in front view slightly concave; frons with scrobes moderately deep, horn rather slender conical with a tubercle above its base; eyes weakly convergent below, comprising nearly two-thirds total width of head; face polished, longitudinally impressed each side of

middle; clypeus hardly prominent; malar space hardly as long as basal width of mandible, constricted, the mouth hardly as broad as narrowest width of face; occipital carina convergent above with posterior margin of eye, very prominent below, its lower end separated from hypostomal carina by a very deep, broad groove; temples from above very weakly oblique, flat, about a third as long as short diameter of eye. Thorax polished, entirely without sculpture; anterior lateral carina of pronotum low, epomia wanting; prescutum rather high, lateral lobes impressed, with a low tubercle above apex of tegula; scutellum high, compressed; subalar tubercle low, not carinate; propodeum (fig. 5) polished, medially longitudinally deeply impressed, carina straight, spiracles broadly oval, apophyses in the form of high transverse carinae, midway between carina and apex; hind femur less than twice as thick in middle as at base, inner calcarium hardly two-fifths as long as basitarsus; areolet small, elongate, recurrent antefurcal, nervulus interstitial, postnervulus broken above middle, nervellus at about lower third. Abdomen slender; second tergite nearly four times as long as broad at base, shorter than first; sheath as long as hind tibia.

Head black and white, the following white, face, clypeus, mouth parts except labial palpi, broad complete orbits and annulus on flagellar joints 4–12; thorax black and white anteriorly and dorsally, pleura, sternum, and propodeum stramineous; the following white, propleura, anterior lateral and humeral margins of pronotum, two discal lines and lateral tubercles on mesoscutum, tegulae, scutellum and its carinae, postscutellum, subalar tubercle; propodeum stained with piceous from base to apophyses, the color darkest at base; legs pale testaceous to stramineous, front coxae largely white, hind tibia yellow, tarsus white; abdomen white with tergites beyond second black at base, first pale piceous above, second with a black band beyond middle, basad of which it is medially pale grayish brown.

Type-locality.—La Ceiba, Honduras.

Type.—Cat. No. 42201, U.S.N.M.

One specimen taken by F. J. Dyer on October 24, 1916.

49. POLYCYRTUS (POLYCYRTUS) BICARINATUS, new species

This and the four following species form a group characterized by having the apical carina apparently complete though with a sharp angular break toward the front medially, this break sometimes not entirely closed.

Female.—Length 9 mm.

Vertex in front view nearly flat; frons with shallow but rather well-defined scrobes, horn stout conical with two small pits above at its base and a median elongate tubercle on frons above; eyes con-

vergent below, comprising nearly two-thirds total width of head; face distinctly, sparsely punctate, rather deeply longitudinally impressed on each side of middle; clypeus in profile not prominent; malar space hardly as long as basal width of mandible, constricted, mouth as broad as narrowest width of face; occipital carina in side view weakly convergent above with posterior margin of eye, very prominent below and separated by a deep groove from hypostomal carina; temples in dorsal view concave, a little more than a third as long as short diameter of eye. Pronotum polished, the posterior groove crenulate, the crenulations in middle extending forward into scrobe as striations, anterior lateral carina prominent, epomia short, humeral margin not prominent anteriorly; prescutum rather high, lateral lobes weakly impressed, the groove around the margin interrupted opposite tegula by a low tubercle; scutellum rather high and weakly compressed; mesopleurum finely sparsely punctate below and anteriorly, prepectal carina complete, obsoletely foveolate; subalar tubercle reduced to a carina; lower division of metapleurum obliquely rugose, upper division sparsely punctate; propodeum with scattered punctures, basal carina straight medially, apical carina forming an acute angle medially from which a single carina extends forward to basal carina, apophyses reduced to high angles in the carina, midway between basal carina and apex; pleural carina distinct; hind femur hardly twice as thick in middle as at apex, inner calcarium fully two-fifths as long as basitarsus; areolet small, elongate, recurrent and nervulus antefurcal, postnervulus broken at middle, nervellus at lower fourth. Abdomen polished, second tergite nearly four times as long as broad at base, but distinctly shorter than first; sheath a little longer than hind tibia.

Ferruginous with head black, palpi and legs ferruginous, hind tarsi yellow, wings hyaline, veins brown, stigma pale.

Type-locality.—Panama, Panama.

Type.—Cat. No. 42202, U.S.N.M.

One specimen without antennae taken April 5, 1923, by R. C. Shannon.

50. POLYCYRTUS (POLYCYRTUS) UNIVITTATUS Cresson

Mesostenus (*Polycyrtus*) *univittatus* CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 148, female, male.

A cotype of each sex from Mexico in the United States National Museum are the basis of the following description.

Female.—Differs structurally from above description of *bicarinatus* as follows: Frontal horn small without either distinct pits or tubercle above at base; eyes comprising much less than two-thirds total width of head; malar space as long as basal width of

mandible, constricted, mouth narrower than narrowest width of face, temples in dorsal view faintly convex. Humeral margins of pronotum roundly prominent anteriorly; prepectal furrow foveolate; subalar tubercle low, noncarinate; lower division of metapleurum coarsely, densely rugose punctate, upper division nearly smooth; propodeum polished before apical carina, arcuately rugose behind, basal carina slightly bowed medially, apical carina not quite closed medially but extending forward from each side to basal carina and setting off a constricted median area; areolet, small, rather short and broad with recurrent not far from middle. Second tergite hardly three times as long as broad at base; sheath barely longer than hind tibia.

Head black and white, face, clypeus, mouth parts, broad complete orbital ring, apex of horn, and annulus on flagellar joints 5–10 white; thorax tricolored; propleura black; pronotum black with broad anterior lateral and humeral margins white; mesoscutum black with only the tubercles above the tegulae white; scutellum and carina and postscutellum white, lateral areas black; mesopleurum and sternum and metapleurum pale ferruginous or testaceous; prepectus, area around subalar tubercle, and upper part of posterior margin of mesopleurum black, the tubercle white, upper portion of red color of mesopleurum and upper division of metapleurum more yellowish; propodeum testaceous with basal suture and a median longitudinal stripe black, the latter broader basad of basal carina and spreading out narrowly along carina; legs and abdomen testaceous, front coxae whitish; wings hyaline, veins brown, stigma pale.

Male.—Essentially like female; sculpture of metapleurum and propodeum much weaker and sparser, apical carina not reaching basal carina but fading out about half way; annulus on flagellar joints 8–15.

51. POLYCYRTUS (POLYCYRTUS) PAULULUS Cresson

Mesostenus (*Polycyrtus*) *paululus* CRESSON, Proc. Acad. Nat. Sci. Phila., 1873, p. 145, female.

A cotype from Mexico in the United States National Museum with the abdomen partly eaten is the basis of the following description.

Female.—Differs structurally from the foregoing description of *bicarinatus* as follows: Frons with scrobes hardly defined, pits and tubercle at base of horn also obsolete; eyes nearly parallel and comprising much less than two-thirds of total width of head; face polished; clypeus in profile very prominent; malar space as long as basal width of mandible; occipital carina less prominent below, the groove separating it from hypostomal carina shallow; temples in dorsal view flat, nearly half as long as short diameter of eye. Pro-

notum tumid along anterior lateral margin but carina obsolete, humeral margin tuberculately prominent anteriorly; prescutum low, lateral lobes not impressed, marginal groove not interrupted by a tubercle; subalar tubercle not carinate; lower division of metapleurum shallowly, rather densely punctate, upper division virtually smooth; propodeum polished except behind, where it is obscurely roughened, apical carina obtusely angled medially with only a short carina extending forward from the angle, apophyses higher than broad at base; hind femur only about one-half thicker in middle than at apex; areolet short and broad, recurrent near apex, nervulus interstitial, postnervulus broken at about the middle, nervellus not far below middle. Second tergite hardly three times as long as broad at base.

Head black and white; face, broad complete orbital ring, clypeus, mouth parts, and annulus beginning on fifth joint of flagellum white; thorax tricolored; propleura white, pronotum black with broad anterior-lateral and humeral margins white; mesoscutum black with two discal lines white; scutellum and postscutellum white, their lateral areas black; mesopleurum and sternum and metapleurum pale testaceous, subalar tubercle white nearly surrounded by black; propodeum yellowish testaceous with basal area and a median and two lateral longitudinal stripes black; legs testaceous with upper surfaces of coxae yellowish, the hind coxa with a narrow piceous line; wings hyaline, veins brown, stigma pale; abdomen black and white; first segment black above and below, white at sides and apex; second tergite broadly black at base, narrowly black at apex with a broad band of white between, lateral margins white, broadening basally; third tergite colored like second but basal black much shorter (rest of abdomen missing in specimen).

52. POLYCYRTUS (POLYCYRTUS) HUMEROSUS, new species

Very similar structurally to *paululus* as described above, differing as follows:

Female.—Frons with scrobes, pits, and tubercles more distinct; face distinctly punctate; malar space distinctly shorter than basal width of mandible; occipital carina very nearly reaching hypostomal carina, obsolete at lower end, temples in dorsal view weakly convex. Propodeum (fig. 4) polished before apical carina, behind the carina medially longitudinally rugose, transversely so at sides, apical carina acutely angled medially with single carina from angle to basal carina, apophyses shorter than broad at base.

In color it differs from *paululus* only as follows: Basal area of propodeum black only along suture, the median stripe broadened on

basal carina, lateral stripes reduced to narrow brownish lines; hind coxae without a dark line; petiole white above; second and third tergites without narrow apical black margins; second white at base and with the black central mark reaching the lateral margins.

Type-locality.—Orizaba, Mexico.

Paratype-locality.—Guatemala.

Type.—Paris Museum.

Paratype.—Cat. No. 42203, U.S.N.M.

Two females, the type labelled further "P. Biart 1462" and the paratype "Angrand 19–55."

53. POLYCYRTUS (POLYCYRTUS) TRICOLOR Brullé

Mesostenus (*Polycyrtus*) *tricolor* BRULLÉ, Hist. Nat. Ins. Hym., vol. 4, 1846, p. 209, female.

Mesostenus tricolor CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 29, female.

A single female specimen in the United States National Museum appears to belong here. It was taken at Soledad, Cuba, on June 8, 1925, by George Salt. This specimen is the basis for the following notes.

Very similar in general form and structure to the two preceding species, but the frontal horn has two deep pits at its base, the occipital carina is distinctly complete to hypostomal carina, the anterior-lateral margin of pronotum is sharply angulate below the middle, the mesopleurum is obliquely striate in the middle and the metapleurum coarsely, densely punctate, and the propodeum is very much like that of *humerosus* with the apophyses even lower.

In color it is very distinct, differing from both of the other species in having the scape below and apex of horn white; thorax entirely black and white, discal white lines of mesoscutum extending nearly the entire length of inner margins of lateral lobes, pleura entirely white except along sutures; propodeum black and white with black pattern much as in *paululus* with entire basal area black and three longitudinal black stripes, the lateral ones, however, much broader than in *paululus;* abdominal color pattern much as in *humerosus;* legs ferruginous with apices of tarsi black.

POLYCYRTUS MANCUS Cresson

Polycyrtus mancus CRESSON, Proc. Acad. Nat. Sci. Phila., 1873, p. 145, female, male.

A male cotype in the United States National Museum differs from the description of the species in having the mandibles black and the petiole yellow dorsally with a black line on each side.

MESOSTENUS SUBTENUIS Cresson

Mesostenus subtenuis CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 29, male.

This is probably a *Polycyrtus* and very likely the same as the specimen described by Brullé as the male of his *trilineatus*. The descriptions show no differences. Brullé's male was from Haiti and Cresson's type from Cuba, while the female of Brullé's species was from Guiana and obviously of a different species from the male.

SPECIES ERRONEOUSLY REFERRED TO POLYCYRTUS

Listrognathus albomaculatus (Cresson) was referred to *Polycyrtus* by Viereck (Proc. U. S. Nat. Mus., vol. 42, 1912, p. 644).

Polycyrtus ? curvilineatus Cameron (Proc. Linn. Soc. N. S. Wales, vol. 37, pt. 1, 1912, p. 175). This Australian species is surely not a *Polycyrtus*, the possession of the frontal horn being apparently the only reason for its tentative assignment to the genus. The sculpture, many feature of structure, and the type of color pattern are foreign to *Polycyrtus*.

Genus POLYCYRTUS Spinola

KEY TO SPECIES

This key is essentially that of Szepligeti [2] expanded to include all the described species of *Polycyrtus*. Because of the nature of most of the descriptions it was necessary to employ largely characters of color. The key is, therefore, far from entirely satisfactory, but will be found helpful in determination of specimens by reduction of the number of descriptions to be consulted.

1. Propodeum without basal carina; frontal horn trihedral. quadrisulcatus Spinola.
   Propodeum with basal carina; frontal horn usually conical ..... 2.
2. Abdomen ferruginous or testaceous ..... 3.
   Abdomen more or less black, segments often margined with white ..... 38.
3. Only the head black ..... 4.
   Thorax also more or less black or piceous ..... 26.
4. Head with at most the clypeus red or pale ..... 5.
   Head with at least the face or orbits pale ..... 18.
5. Clypeus pale or red ..... 6.
   Clypeus black ..... 12.
   (curvispina Cameron [Costa Rica]. Description says "ore albo," but whether clypeus is included is not clear. Can be run no farther in key on basis of original description.)
6. Clypeus red ..... 7.
   Clypeus pale ..... 8.

[2] Ann. Mus. Nat. Hung., vol. 14, 1916, p. 268.

7. Propodeum rugose between the apophyses.
tinctipennis Cameron, female, male (Panama).
rugulosus Szepligeti, male (Bolivia).
(No difference between these two species appears in the descriptions.)
Propodeum smooth between the apophyses.
minutus Cushman, female (Brazil).
8. Frontal horn white—**riojanus** Brethes, male (Argentina).
Frontal horn black—9.
9. Apophyses very large—**areolatus** Cushman, female (Panama).
Apophyses small or moderate in size—10.
10. Frontal horn large; apophyses in female not especially reduced, in male tuberculiform—**boliviensis** Cushman, female, male (Boliva).
Forntal horn and apophyses much reduced—11.
11. Stigma black; 15 mm—**clypealis** Szepligeti, male (Bolivia).
Stigma yellow; smaller—**testaceus** Taschenberg, variety.
12. Propodeum without apophyses.
testaceus Taschenberg, female, male (Brazil).
Propodeum with apophyses—13.
13. Scutellar carinae white; apophyses short—**nigriceps** Brullé, male (Brazil).
Scutellar carinae not white—14.
14. Palpi testaceous—15.
Palpi yellow—17.
15. Apical carina complete, apophyses low cariniform; ovipositor sheath fully as long as hind tibia—**bicarinatus** Cushman, female (Panama).
Apical carina absent, apophyses long; ovipositor sheath much shorter than hind tibia—16.
16. Ovipositor sheath a little longer than first segment of abdomen.
xanthocarpus Szepligeti, female (Bolivia).
Ovipositor sheath much longer than first segment.
inornatus Cushman, female (Panama).
17. Apophyses long and acute—**lucidator** Erichson, female (British Guiana).
Apophyses of moderate size, conical, a little longer than wide at base.
melanocephalus Cameron, female (British Guiana).
18. Orbits black—19.
Inner orbits white—20.
19. Areolet more quadrate—**testaceus** Taschenberg var. 3 (Venezuela).
Areolet elongate; ovipositor long.
caudatus Szepligeti, female (Panama; Bolivia).
20. Frontal horn black—21.
Frontal horn white at least at apex—22.
21. Scutellum conical—**similis** Szepligeti, male (Venezuela).
Scutellum convex; occipital carina prominent below; malar space much shorter than basal width of mandible.
ornatifrons Cushman, female (Panama).
22. Face black—**albispina** Szepligeti, female (Bolivia).
Face white, at least at sides—23.
(**pallidus** Cresson, male [Mexico]. Will run no farther in key on basis of original description.)
23. Propodeum longitudinally impressed; second recurrent vein not interstitial.
szepligetii, new name, female (Bolivia).
(= **canaliculatus** Szepligeti [not Cameron]).
Propodeum not impressed—24.

24. Posterior orbits white——alboannulatus Szepligeti, male (Paraguay).
Posterior orbits black, at most with a small white spot——25.
25. Second recurrent interstitial——surinamensis Szepligeti, female (Surinam).
Second recurrent antefurcal——buscki Cushman, female, male (Panama).
26. Propodeum white marked, at least the apophyses white——27.
Propodeum not white marked——32.
27. Mesopleurum red at least below, usually black and white above——28.
Mesopleurum black and yellow or white——31.
28. Mesopleurum not at all black; propodeum coarsely rugose.
bulbosus Cushman, female (Mexico).
Mesopleurum more or less black above——29.
29. Propodeum black——giacomellii Schrottky, female (Argentina).
Propodeum red——30.
30. Propodeum with a median black stripe.
univittatus Cresson, female, male (Mexico) (See 37).
Propodeum not black-marked——rufipleuris Szepligeti, female, male (Brazil).
31. Propodeum mostly red——semirufus Szepligeti, female, male (Brazil).
Propodeum black and white——infractus Cushman, female (Panama).
32. Propodeum black——33.
Propodeum red——34.
(albolineatus Cameron, female [British Guiana]. Will run no farther in key on basis of original description.)
33. Scutellum black, only the carinae white.
emaculatus Szepligeti, female, male (Bolivia).
Scutellum and postscutellum white.
alboannularis Ashmead, female (Lower California).
34. Propodeum longitudinally impressed.
excavatus Szepligeti, female, male (Bolivia).
sulcatilobus Cushman, female (Brazil).
(*sulcatilobus* agrees with the very brief description of *excavatus*).
Propodeum in basal middle with a triangular impression, between the apophyses flat——35.
Propodeum not impressed——37.
35. Scutellar carinae black——chiriquensis Cameron, female (Panama).
Scutellar carinae white——36.
36. Propodeal carina straight——rufiventris Spinola, female, male (Guiana).
Propodeal carina curved forward medially.
saladonis Cushman, female, male (Argentina).
37. Apophyses cariniform; mesoscutum with a white spot above each tegula.
univittatus Cresson, female, male (Mexico) (See 30).
Apophyses very long; mesoscutum without such white spots.
tubulifera (Viereck), female (Peru).
38. Thorax red——39.
Thorax not entirely red——57.
39. Hind tibia black——40.
Hind tibia red or yellow——41.
40. Head red——nigrotibialis Szepligeti, female (Bolivia).
Head black and white——elegans (Viereck), male (Peru).
41. Face white at least laterally——42.
Face black——46.
(sartor (Fabricius). Can be run no farther in key on basis of original description or that of Spinola. Brullé places it in his second group of *Mesostenus*, saying that his specimen is not the same species as that described by Spinola, since his lacked the frontal horn. This would exclude it from *Polycyrtus*.)

42. Orbits black ..... 43.
At least frontal orbits white ..... 45.
43. Metapleurum sparsely punctate ..... convergens Cushman, female (Peru).
Metapleurum weakly rugose 44
44. Apophyses slender; first recurrent and nervulus interstitial.
marginatus Szepligeti, female (Bolivia).
Apophyses short and stout; first recurrent antefurcal; nervulus postfurcal.
prominens Cushman, female (Bolivia).
(These are only characters in description of *marginatus*, with which *prominens* does not agree.)
45. Posterior orbits mostly and face entirely white.
gibbulus Szepligeti, female (Bolivia).
Posterior orbits entirely and face medially black.
isthmus Cushman, female (Panama).
(The species described by Spinola as *capitator* [Fabricius] will apparently run here, but differs from *isthmus* by having the propodeum posteriorly strongly punctate.)
46. Scape white below ..... leucostomus Taschenberg, male (Brazil).
Scape black or reddish below ..... 47.
47. Abdomen red, with third and following tergites black at base.
atriceps Cresson, female (Mexico).
Abdomen black, or black and white, with at most petiole red ..... 48.
48. Propodeum strongly impressed in basal half ..... 49.
Propodeum at most shallowly impressed before basal carina ..... 51.
(curviventris Cameron, female [Panama]. Runs to 48 but propodeal character not mentioned in description.)
49. Clypeus black ..... nigriclypeatus Cushman, female (Panama).
Clypeus yellow ..... 50.
50. Tergites broadly white at apex ..... nudus Szepligeti, female (Bolivia).
Tergites at most narrowly margined with reddish.
impressus Cushman, female (Bolivia).
51. Hind femur red ..... 52.
Hind femur black ..... 54.
52. Tergites distinctly white-margined apically.
paranensis Cushman, female (Brazil).
Tergites not distinctly white-margined apically, but broadly so laterally ..... 53.
53. Frontal horn black ..... capitator (Fabricius), female, male (South America).
nigriventris Cameron, female (British Guiana).
(Brullé's description of *capitator* and that of *nigriventris* read like two descriptions of the same species.)
Frontal horn white ..... albiniclavus Cushman, female (French Guiana).
54. Clypeus black or more or less piceous.
parviclavus Cushman, female (Peru).
Clypeus distinctly white ..... 55.
55. Tergites beyond second not margined with white; hypostomal carinae very high and meeting along median line ..... inca Cushman, female (Peru).
Tergites distinctly white-margined; hypostomal carinae not so high ..... 56.
56. Frons with a minute tubercle above base of horn; clypeal suture straight.
femoratus Spinola, female (Guiana).
Frons with two fossulae above base of horn; clypeal suture strongly arched.
brevigenalis Cushman, female (Panama).
57. Thorax red and black, or piceous, often white-marked ..... 58.
Thorax white or yellowish and black ..... 79.

58. Frontal orbits and mesoscutum not white-marked ..... 59.
Frontal orbits white; mesoscutum usually white-marked ..... 64.
59. Scutellum black ..... 60.
Scutellum red ..... 63.
60. Hind femur red, coxae piceous ..... furvus Cresson, male (Mexico).
Hind femur black, coxae red ..... 61.
61. Tergites white apically ..... nigroscutellatus Brullé,[3] female (Brazil).
Tergites white only laterally ..... 62.
62. Propodeum entirely red; clypeus black.
atrinasutus Cushman, female (Brazil).
Propodeum black basally; clypeus white.
constricticlavus Cushman, female (Brazil).
63. Apophyses very long ..... xanthothorax Brullé, female, male (Brazil).
Apophyses short ..... medialbus Cushman, female (Brazil).
64. Margin of mesoscutum not white ..... 65.
Margin of mesoscutum white ..... 76.
(acouratus Cresson, female [Mexico]. Point not definitely covered in description: "two short lines on each lateral lobe of mesothorax." Popodeum red and black.)
65. Propodeum red or red and yellow, not at all black ..... 66.
Propodeum red and black or black and yellow ..... 71.
66. Propodeum red and yellow ..... rufomaculatus Cameron, male (Cuba).
Propodeum with at most the apophyses yellow ..... 67.
67. Face black ..... erythrosternus Cameron, female (Panama).
Face white ..... 68.
68. Orbits entirely white ..... 69.
Orbits not entirely white ..... 70.
69. Second tergite black in basal middle ..... manni Cushman, female (Bolivia).
Second tergite with an elongate oval white spot in basal middle.
circumfluens Cushman, female, male (French Guiana).
70. Posterior orbits black with a white spot; apophyses very long and curved.
copiosus Cresson, female, male (Mexico).
White orbital ring interrupted only at bottom of eye; apophyses short, straight ..... confusus Cushman, female (Mexico).
71. Propodeum red and black ..... 72.
Propodeum black and yellow ..... 75.
72. Apical carina of propodeum present.
pallidibalteatus Cameron, female (Mexico).
Apical carina wanting ..... 73.
73. Propodeum with a median black stripe; hind femora red.
areolaris Cushman, female, male (Panama).
Propodeum transversely black before carina; hind femora black ..... 74.
74. Hind femur black only above; occipital carina not meeting hypostomal carina ..... cockerellae Viereck, female (Guatemala).
Hind femur entirely black; occipital carina meeting hypostomal carina.
mediotinctus Cushman, female (Honduras).
75. Propodeum black only at base ..... trochanteratus Szepligeti, female (Brazil).
Propodeum with three longitudinal black stripes.
trilineatus Brullé, female (not male) (Guiana) (See 92).
76. Propodeum not at all black ..... 77.
Propodeum more or less black and piceous ..... 78.

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[3] Szepligeti's determination of *nigroscutellatus* is apparently wrong. Brullé's type female is said to have the apophyses short while Szepligeti's male is said to have them long. The usual antigeny is the reverse of this.

77. Prescutum not channeled medially; propodeal apophyses present.
histrio Spinola, female, male (South America).
Prescutum channeled medially; propodeum without apophyses.
guaruja Bréthes, female (Argentina).
78. Propodeum with three longitudinal black stripes.
leprieuri Spinola, male (Guiana).
Propodeum largely piceous black.
inquinatus Cushman, female, male (Argentina).
79. Hind coxae red or stramineous ..... 80.
Hind coxae white or yellowish and black ..... 94.
(**chontalensis** Cameron, male [Panama] and **guatemalensis** Cameron, male, [Guatemala] can be run no farther in key on basis of original descriptions).
80. Propodeum posteriorly punctate or rugose ..... 81.
Propodeum polished and impunctate ..... 84.
81. Apophyses long and curved ..... **suturalis** Brullé, female (Brazil).
Apophyses cariniform ..... 82.
82. Thorax black and white ..... **tricolor** Brullé, female (Cuba).
Thorax black and stramineous ..... 83.
83. Second tergite black at base and apex ..... **paululus** Cresson, female (Mexico).
Second tergite white at base and apex.
humerosus Cushman, female (Guatemala; Mexico).
84. Only the first three segments black ..... **leucopus** Brullé, female (Brazil).
All segments more or less black ..... 85.
85. Orbits not entirely yellow ..... 86.
Orbits entirely yellow ..... 90.
86. Hind femur entirely red ..... 87.
Hind femur more or less black at apex ..... 88.
87. Propodeum black at base, with three longitudinal black lines.
xanthopus Brullé, male (Brazil).
Propodeum brown at base and with a large brown median spot before the apophyses ..... **emarginatus** Brullé, male (South America).
88. Hind femur black only at apex ..... **tuberculatus** Brullé, female (Brazil).
Hind femur black throughout its length at least on inner side and below. 89.
89. Head entirely black ..... **proximannulatus** Cushman, female (Bolivia).
Head white-marked ..... **colliculatus** Cushman, female (Brazil).
90. Propodeum mostly yellow ..... 91.
Propodeum mostly black ..... 93.
91. Mesoscutum immaculate black ..... **macer** Cresson, female, male (Mexico).
cruciatus Cameron, female (Mexico).
(Comparison of descriptions shows no differences.)
Mesoscutum with two short white lines on disk ..... 92.
92. Propodeum with transverse black bands before and behind basal carina and three longitudinal stripes.
neglectus Cushman, female, male (southeastern United States).
Propodeum black at base with three black longitudinal stripes.
trilineatus Brullé, male (not female) (Haiti) (See 75).
93. Thorax strongly sculptured ..... **fulvipes** Cameron, male (Guatemala).
Thorax polished ..... **amoenus** (Viereck), female (Paraguay).
94. Antennae without annulus ..... **nigricornis** Szepligeti, female (Colombia).
Antennae with annulus 95
95. Hind tibia entirely yellow 96
Hind tibia more or less black 107

96. Propodeum stramineous, more or less stained with brownish above, longitudinally impressed medially, apophyses cariniform.
carinispinis Cushman, female (Honduras).
Propodeum yellow with black markings 97
97. Second tergite black throughout above 98
Second tergite white medially near base 101
98. Posterior orbital white mark interrupted above 99
Posterior orbital white mark not interrupted above 100
99. Propodeum with a transverse black band behind basal carina; frontal horn and mandibles black ..... **ferox** Cresson, female (Mexico).
Propodeum without such a black mark; frontal horn apically and mandibles white ..... **junceus** Cresson, male (Mexico).
100. Frontal horn black; posterior tarsi white; apophyses flattened.
acerbus Cresson, female (Mexico).
Frontal horn white; posterior tarsi red; apophyses slender conical.
lituratus Brullé, female, male (Cuba).
101. Propodeum with a transverse black mark on basal carina 102
Propodeum without such a black mark 106
102. Mandibles largely or entirely black 103
Mandibles yellow 105
103. Pleura largely reddish yellow 104
Pleura largely black; petiole black above.
fulvofemoratus Cameron, female (Guatemala).
104. Subbasal white spot of second tergite transversely quadrilateral.
duplicatus Cushman, female (Panama).
Subbasal white spot of second tergite triangular.
triangularis Cushman, female (Panama).
105. Scutellum discally black, yellow at apex.
major Cresson, female, male (Mexico).
Scutellum entirely yellow ..... **mancus** Cresson, female, male (Mexico).
106. Propodeum longitudinally furrowed; black mark of second tergite acute at base ..... **canaliculatus** Cameron, male (Guatemala)
Propodeum not furrowed; black mark of second tergite truncate at base.
semialbus (Cresson), female, male (Cuba).
montezuma Cameron, male (Mexico).
107. Hind tibia entirely black ..... **melanoleucus** Brullé, male (Mexico).
Hind tibia not entirely black 108
108. Hind tibia black above, pale below ..... 109.
Hind tibia black at base or at both base and apex ..... 110.
109. A stouter species with metapleura coarsely punctate; wings infumate apically ..... **collinus** Cameron, female (Guatemala).
A more slender species with metapleura barely punctate; wings not infumate apically ..... **confirmatus** Cameron, female (Guatemala).
110. Hind tibia black at base and apex.
obtusispina Cameron, female (Guatemala).
Hind tibia black at base only ..... 111.
111. Propodeum with strong apophyses.
blanditus Cameron, female (Guatemala).
Propodeum transversely striate, without apophyses.
reliquus Cresson, female (Mexico).
(=?Glodianus).

INDEX

[In this index accepted genera are in bold face type; synonyms, both generic and specific, in italics; species erroneously placed in the genus in roman type in paranthesis; valid species i n roman]

	Page
accuratus	57
acerbus	59
albiniclavus	3, 9, 56
albispina	54
alboannularis	55
alboannulatus	55
albolineatus	55
(albomaculatus)	53
amoenus	12, 58
areolaris	6, 30, 57
areolatus	3, 15, 54
atriceps	56
atrinasutus	5, 28, 57
bicarinatus	7, 48, 54
blanditus	59
boliviensis	3, 14, 54
brevigenalis	5, 21, 56
bulbosus	3, 12, 46, 55
buscki	3, 11, 55
canaliculatus Cameron	59
canaliculatus Szepligeti	54
capitator	3, 8, 56
carinispinis	3, 12, 47, 59
caudatus	54
cephalotor	8
chiriquensis	55
chontalensis	58
circumfluens	6, 32, 57
clypealis	54
cockerellae	5, 28, 57
colliculatus	6, 35, 58
collinus	6, 43, 59
confirmatus	59
confusus	6, 33, 57
constricticlavus	5, 24, 57
convergens	5, 18, 56
copiosus	6, 34, 57
cruciatus	58
Cryptanuridimorpha	1, 2, 7
Cryptopterigimorpha	1, 7
(curvilineatus)	53
curvispina	53
curviventris	56
duplicatus	6, 38, 59
elegans	2, 7, 55
emaculatus	55
emarginatus	58
erythrosternus	57
excavatus	55
femoratus	56
ferox	59
fulvipes	58
fulvofemoratus	59
furvus	57
giacomellii	55
gibbulus	56
guaruja	58
guatemalensis	58
histrio	12, 58
humerosus	7, 51, 58
impressus	5, 16, 56
inca	2, 10, 56
infractus	3, 12, 45, 55
inornatus	3, 13, 54
inquinatus	6, 29, 58
isthmus	5, 18, 56
junceus	59
leprieuri	58
leucopus	58
leucostomus	56
Listrognathus	53
lituratus	6, 41, 59
lucidator	54
macer	6, 37, 58
major	6, 40, 59
mancus	38, 52, 59
manni	6, 32, 57
marginatus	56
medialbus	5, 26, 57
mediotinctus	6, 30, 57
melanocephalus	54
melanoleucus	59
minutus	3, 14, 54
montezuma	6, 40, 59
neglectus	6, 44, 58
nigriceps	54
nigriclypeatus	5, 16, 56
nigricornis	58
nigriventris	8, 56
nigroscutellatus	57
nigrotibialis	7, 55
nudus	56
obtusispina	59
ornatifrons	3, 12, 54
pallidibalteatus	57
pallidus	54
paranensis	5, 20, 56
parviclavus	5, 19, 56
paululus	7, 50, 58
Polycyrtimorpha	1, 12
Polycyrtus	1, 2, 12, 53
prominens	5, 17, 56
proximannulatus	5, 23, 58
quadrisulcatus	53
reliquus	59
riojanus	54
rufipleuris	3, 12, 44, 55
rufiventris	55

	Page
rufomaculatus	57
rugulosus	54
saladonis	5, 23, 55
sartor	55
semialbus	6, 40, 59
semirufus	55
similis	54
subtenuis	53
sulcatilobus	5, 22, 55
surinamensis	55
suturalis	58
szepligetii	54
testaceus	54
tinctipennis	54
triangularis	6, 39, 59
tricolor	7, 52, 58
trilineatus	57, 58
trochanteratus	57
tuberculatus	58
tubulifera	3, 7, 10, 55
univittatus	7, 49, 55
xanthocarpus	54
xanthopus	59
xanthothorax	5, 27, 57

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NOTES ON SOME ACALYPTRATE FLIES IN THE UNITED STATES NATIONAL MUSEUM

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INTRODUCTION

During recent years I have given some of spare time to a partial study of the Oriental and Australasian Ortalidae, using for the greater part of the work the material in the collection of the United States National Museum, and having found in that collection some undescribed species, coupled with a few interesting characters seemingly overlooked by other writers on the family, I am presenting herein a summary of some of my findings. I also present herein descriptions of Helomyzidae and Periscelidae.

The types of the new species are in the collection of the United States National Museum.

Genus EUPROSOPIA Macquart

Euprosopia Macquart, Dipteres Exotiques, Suppl. 2, p. 89, 1847.

This genus is distinguished from its allies by the very large lower calypter, which is quite as expansive as in many Tachinidae and would appear to belie the name "Acalyptrate" as applied to the subfamily to which it belongs, the presence of hairs or setulae on the posterior side of the upper surface of the stem vein as in certain Calliphoridae, and the flattened central carina of the face with its deep lateral antennal foveae. The species are characteristically marked on the wings with many dark spots or interrupted fasciae, and in one species, which is described herein, the wings are conspicuously fasciate with black.

The genus contains some well-defined segregates which might reasonably be accepted as at least subgenera. In the group in which the tegulae, or a process below these, extend forward along the noto-

pleural suture the posterior notopleural bristle is slightly removed from the lateral margin of mesonotum and directed upward or mesad, while in the species which have no such abnormal tegular development this bristle is situated close to the lateral margin of the mesonotum and backwardly directed. Of the first group I have seen *tegularia* Malloch, *macrotegularia* Malloch, *metallica* Malloch, and *longifacies* Hendel. There are also species in which all four vertical bristles are present and others in which but one pair is developed.

Group LONGIFACIES

This group has the arista with hairs on the basal fourth or less which are not less than half as long as the width of the third antennal segment, the head not less than 1.5 as high as wide when seen from in front, and the frons longer than its anterior width, with only two vertical bristles developed.

I have three species before me that belong to this group, not one of which I can determine as *longifacies* Hendel. I give below a synopsis of the characters of the four species, using Hendel's very full description of *longifacies* as a basis for distinguishing that species.

KEY TO THE SPECIES OF EUPROSOPIA

1. Frons not appreciably over 1.5 as long as its width at anterior extremity---2.
   Frons over twice as long as its width at anterior extremity---3.
2. Scutellum with six bristles; the greater portion of fore femora, and the mid and hind femora much less extensively, browned; basal segment of all tarsi reddish yellow on basal two-thirds, the second segment of hind tarsi reddish; humeri somewhat reddish; fore femur with long black bristles on entire extent of the posterodorsal, and the apical half of the posteroventral, surface---**longifacies** Hendel.
   Scutellum with four bristles; all femora fuscous, and grey dusted, very narrowly pale at apices; basal segment of all tarsi yellowish white, remainder of tarsi deep back; humeri black, densely grey dusted; fore femur with a full series of moderately long posterodorsal bristles, but without any bristles, only hairs, on the posteroventral surface---**semiarmata**, new species.
3. Femora largely yellow, browned apically; anterior margin of dorsum of thorax quite noticeably humped between humeri and with rather dense curled yellow hairs on each side at downward curve; fourth visible abdominal tergite of female without a patch of black hairs in center of anterior margin; fascia over outer cross vein of wing not complete, inconspicuous---**omei**, new species.
3. Femora entirely fuscous, grey dusted; anterior margin of thoracic dorsum not visibly humped, and without exceptional adornment of pale hairs; fourth visible abdominal tergite of female with a somewhat triangular patch of erect black bristly hairs in center of anterior margin, the apex of the patch reaching middle of the tergite; fascia over outer cross vein of wing complete and conspicuous---**grahami**, new species.

EUPROSOPIA LONGIFACIES Hendel

Euprosopia longifacies HENDEL, Genera Insectorum, Fam. Platystominae (fig.); description, Abhand. k. k. Zool.-Bot. Gesellsch., Wien, vol. 8. heft 1, p. 350, 1914.

This species was described from Formosa, and only the female is known. Nothing is mentioned in the original description of a process either on the tegula or below it, but such a process or processes may be present, as Hendel apparently paid no attention to the forward production of the tegula in *nigropunctata* Hendel, though such a process is present in two females identified by him which are now before me.

In addition to the characters listed in the key for the distinction of *longifacies* from the next species I may mention the more distinctly vittate, and golden haired, mesonotum, and the less regular and numerous dark spots on the wings.

EUPROSOPIA SEMIARMATA, new species

Female.—Head testaceous yellow, face with a brown mark in lower extremity of each antennal fovea and a streak of same color from there to lower margin of face; occiput fuscous on each side of upper half and grey dusted, frons brown on each side above and on ocellar region, and with grey dust on the orbital stripes on dark part; antennae, palpi, and labrum testaceous yellow. Thorax fuscous, humeri not yellow, densely grey dusted, with three faint dark brown vittae; mesonotum with black decumbent hairs; pleura concolorous with mesonotum, mesopleura not marked with dark spots; pteropleural hairs dark in front, pale behind; scutellum pale haired at apex. Abdomen colored as thorax, defective in type, but with traces of large dark brown marks on the tergites, which are but poorly defined, the short discal hairs black, the apical hairs pale. Legs fuscous, tibiae largely yellow basally, basal segment of each tarsus yellowish white on basal two-thirds. Wing as Figure 1. Edges of calyptrae dark.

FIGURE 1.—WING OF EUPROSOPIA SEMIARMATA

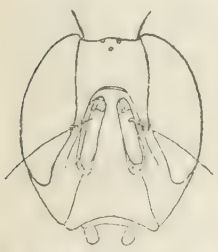

FIGURE 2.—HEAD OF EUPROSOPIA SEMIARMATA FROM IN FRONT

Head about 1.25 as high as wide in front (fig. 2); frons depressed in center, about 1.5 as long as its anterior width, outer verticals only present; arista haired on less than its basal fourth; facial carina microscopically transversely striate above, becoming granulose below. Humeral bristle present, posterior notopleural bristle on a slight

elevation, directed mesad; four bristles on hind margin of mesonotum, and four on the margin of scutellum. Tarsi quite noticeably widened apically. There is a slender chitinous process on the right side of thorax below the tegula which extends forward two-thirds of the way to the humerus and is bent at apex.

Length, 10 mm.

Type.—Female, Cat. No. 43074, U.S.N.M. Zamboanga, Mindanao, P. I. (C. F. Baker).

EUPROSOPIA OMEI, new species

Female.—Differs from the next preceding species in having the frons paler, the labrum browned on sides, the dense, rather long, soft hairs in center of second visible tergite of abdomen yellowish white, the legs differently colored as noted in the foregoing key, and the wings marked as Figure 3.

FIGURE 3.—WING OF EUPROSOPIA OMEI

A larger species than *semiarmata*, with the head higher and the frons narrower, especially above (figs. 2 and 4), the anterior margin of the mesonotum humped up and haired as stated in the key, the tegulae with a subconical process projecting forward about midway to the humeri, and below these processes another similar in shape and about equal in length. The central portion of the second visible tergite of the abdomen is quite copiously furnished with whitish yellow decumbent soft hairs, and the central portion of the third tergite between the brown elongate marks is haired also, but the hairs are much shorter and finer, especially posteriorly.

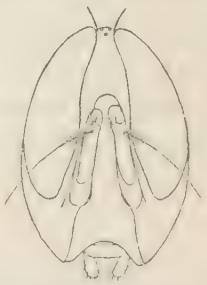

FIGURE 4.—HEAD OF EUPROSOPIA OMEI FROM IN FRONT

Length, 12 mm.

Mount Omei, Szechwan, China, 11,000 feet, August 20, 1921 (D. C. Graham).

Type.—Female, Cat. No. 43073, U.S.N.M.

EUPROSOPIA GRAHAMI, new species

Male and female.—Apparently a common species, and readily distinguished from its closest allies by the rather broad subapical fascia of the wing.

Head similar in color to that of the next preceding species, the sides of the labrum more or less browned or infuscated. Thoracic dorsum with three dark vittae, the central one linear; all hairs yellowish, the bristles black. Abdomen densely whitish grey dusted, with a pair of conspicuous black spots on each tergite from second to

fourth visible, the hairs on the dark portions blackish, those on apices of tergites and most of the grey dusted portions yellowish white. Femora fuscous, mid pair brownish basally, all tibiae rather variable in color, sometimes brownish yellow, sometimes darker, basal segment of each tarsus yellowish white except at apex. Wings marked as in Figure 5. Calyptrae white. Halteres yellow.

Head shaped as in *omei*, the vertex rather deeply sunken in the female, less so in the male, the latter with the vertical width about twice that of the female, but two vertical bristles present; arista without an apical palette in the male. Thorax narrowed in front in the female, hardly so in the male, neither sex with exceptional form or armature; tegulae of the male very slightly produced forward and no pleural process below them, in the female the tegulae are produced forward in the form of a stout cone about one-third of the distance to the humeri, and below these processes there is another similar in shape and slightly shorter which has the apex rounded, scutellum with six marginal bristles. Abdomen without exceptional hairing but for the triangular patch of erect short black hairs in center of the anterior margin of fourth visible tergite.

FIGURE 5.—EUROSOPIA GRAHAMI

Length, 11–12 mm.

Type.—Male, Cat. No. 43070, U.S.N.M. Male, Shin Kai Si, Mount Omei, Szechwan, China, 4,400 feet; allotype, Suifu, Szechwan, China; paratypes, same localities as the type and allotype, 11 specimens (D. C. Graham).

There is considerable variation in the minor details of the wing markings in the type series but the general plan of the markings is similar throughout.

Group METALLICA

The only species known to me which is placed in this group agrees closely in most particulars with the foregoing one, having the head seen from in front much higher than wide, the frons over twice as long as wide anteriorly, the arista with distinct hairs on basal fourth, and the tegulae produced forward in a long process. It differs from all four species already dealt with in having the thorax and abdomen metallic blue, and in this respect it differs also from any species of the entire genus. In fact, Hendel uses as his principal distinguishing character for the separation of this genus from *Lamprogaster* in his key the metallic color of the latter as against the lack of metallic color in *Euprosopia*. He did not notice the presence of hairs on the stem vein of the wing in *Euprosopia* and their absence

in *Lamprogaster*, the most reliable character for the separation of the two genera.

EUPROSOPIA METALLICA, new species

Female.—Head testaceous yellow; frons deep black, the orbits narrowly greyish white dusted, the dust carried downward on parafacials to about the level of apex of third antennal segment; parafacials dark brown, a black quadrate mark covering the area below eye from in front of antennal fovea to level of hind margin of eye; face centrally undusted; occiput fuscous in center above, densely greyish white dusted; antennae and aristae blackish brown; palpi black; labrum shining black. Thorax black, mesonotum glossy dark blue-green, castaneous on side behind suture, and with an angular patch of whitish dust on each side in front of suture; pleura partly covered with dense whitish dust, most conspicuous on mesopleura and sternopleura, the pteropleural hairs long and white behind, short and dark in front; scutellum metallic blue-green. Abdominal dorsum concolorous with mesonotum, the fourth visible tergite broadly castaneous or cupreous on each side; hairs on venter basally pale, the others dark. Legs black, basal two-thirds of metatarsus of mid and hind legs whitish yellow. Wings hyaline, with a number of black spots and streaks at bases extending to apices of basal cells and furcation of veins 2 and 3, a broad fascia of same color extending from slightly before apex of subcosta to near apex of first vein along the costa, inclosing three small hyaline marks near or on costa, covering the inner cross vein, and running slightly diagonally to hind margin where it is less intensely colored; a similar fascia at about its own width from the first one extends from the costa about midway between apices of first and second veins to hind margin, incloses a small hyaline mark on costa, covers the outer cross vein, and connects with another fascia at hind margin which runs obliquely to costa, forming with it a V-shaped mark, the inner margin of the outer arm before apex of second vein, the outer margin of same expanding to tip of wing and filling almost all of apex of the first posterior cell, with a small hyaline spot in apex of submarginal cell, and the outer lower outline more or less dentate; in addition to these conspicuous fasciae, there is a small dark streak on the costa between each of them, and some small spots in the anal region, while the hind margin of the latter is also dark. Calyptrae whitish, with dark margins. Knobs of halteres brown.

Head about 1.75 as high as wide in front; frons over twice as long as its width in front; inner verticals minute, directed outward, outer pair of moderate length; antennae about as long as distance from apex to mouth; basal fifth of aristae with some hairs which are about half as long as width of third antennal segment; upper extremity of facial carina not noticeably depressed nor glossy, rather distinctly

transversely striate on upper portion, the striae becoming less evident below and disappearing below middle; cheek about as high as length of antennae; labrum higher than width of third antennal segment, with minute striae commencing at center and running diagonally outward; palpi broad. Humeral lacking, posterior notopleural sloping forward and upward, two supra-alars and one postalar, the mesonotum with short stiff decumbent black hairs; scutellum rounded, microscopically striate and with six marginal bristles situated at apex. All tarsi quite conspicuously widened. Inner cross vein of wing oblique, close to middle of discal cell; first posterior cell narrowed at apex. Tegulae carried forward spikelike about two-thirds of distance to humeri.

Length, 15 mm.

Type.—Female, Cat. No. 43075, U.S.N.M. Mount Mayo, Davau, Mindanao, P. I., May, 1927 (A. L. Duyay); paratype.

As already mentioned, this species is unique in the genus on account of its metallic blue-green body color.

Group TENUICORNIS

The genotype is *tenuicornis* Macquart, and the characterization of the present group may be accepted as that of the genus in a restricted sense. The head is not as high and narrow as in the preceding two groups, being less than 1.5 as high as wide from in front, the vertex has but two well-developed bristles, and the arista is bare. The labrum is moderately high, the scutellum is not emarginate at apex, and the tegulae are sometimes prolonged forward in the females.

There are a number of species referable here, the following two being before me at this time:

EUPROSOPIA TENUICORNIS Macquart

Euprosopia tenuicornis MACQUART, Dipt. Exot., Suppl. 2, p. 90, 1847.

An Australian species in which the male has a pair of long, slightly flattened, and distinctly curled hairs on one of the segments of the fore tarsus. Both the species now before me have the rim of the upper calypter dark, that of the lower one whitish, and the disk of the latter dark brown.

EUPROSOPIA SCATOPHAGA Malloch

Euprosopia scatophaga MALLOCH, Proc. Linn. Soc. N. S. W., vol. 55, p. — (1930).

Also an Australian species which is at present in the press so that I am unable to give the reference to the description. It is very similar to *tenuicornis*, but the wings are differently marked and the male has no long hairs on any segment of the fore tarsus.

Group SEPARATA

This group is very similar to the preceding one, but the species all have the scutellum more or less deeply sulcate centrally at apex and on each side of the sulcus a distinct convexity which is either glossy black or brown and distinctly shining. The arista is bare at base and the tegulae sometimes elongated.

I have before me at present the following three species, *separata* Hendel, *conjuncta* Hendel, and *biarmata* Malloch, all Australian.

Group SEXPUNCTATA

This group was named *Notopsila* by Osten Sacken, his intention being to supplant *Pachycephala* Doleschal, which was preoccupied, the genotype being *mohnikei* of that author. Hendel does not include this species in his key, nor does he include *sexpunctata* Osten Sacken, possibly because they were unknown to him. I have before me specimens which are apparently referable to the last-mentioned species, and give below some data upon the species and one other.

Osten Sacken, in defining the genus *Notopsila* said that the clypeus is entirely concealed, but this is not the case, there being a very narrow, vertical, chitinous strip of it visible in all the specimens I have examined, though it is very much narrower than in any species of *Euprosopia* in any of the other groups known to me. He emphasizes the emargination of the tip of the scutellum as a character and also the disposition of the marginal bristles on same, but, like Hendel, I am not inclined to consider this as a good character for distinguishing genera in this subfamily. The structure of the scutellum differs from that of the *separata* group in that there are no glossy convex lateral areas. One striking character in the two species before me is the much wider space between the antennal insertions, the flat facial carina at this point being, as Osten Sacken states, about half as wide as the frons at vertex. There are but two vertical bristles present, and the arista is bare or pubescent at base. The tegulae are not elongated.

EUPROSOPIA SEXPUNCTATA Osten Sacken

Euprosopia sexpunctata OSTEN SACKEN, Berl. Ent. Zeitschr., vol. 26, heft 2, 1882, p. 210. (*Notopsila.*)

The scutellum is not always centrally emarginate at apex, some of the specimens having it regularly rounded or slightly transverse. The face is testaceous yellow, with a small black spot in the lower extremity of each antennal fovea, one on each parafacial opposite base of antennæ, and one on each side of the facial carina which

form with the black second antennal segments an almost complete black transverse band at that point. The wing markings consist of pale fuscous spots, not fasciae.

The very broad facial carina is sharply margined on the sides and has many fine striae which diverge vertically from upper to lower margin, and in none of the specimens before me can I detect any hairs on the arista.

Locality, Samar Island, P. I. (C. F. Baker).

EUPROSOPIA DORSATA Hendel

Euprosopia dorsata HENDEL, Abhand. k. k. Zool.-Bot. Gesellsch., Wien, vol. 8, heft. 1, 1914, p. 340.

This species may possibly prove to be but a variety of the foregoing one as the only character that appears to me to be of consequence in distinguishing it is the pubescent base of the arista. The scutellum is not emarginate at apex, but in many examples of *scæpunctata* before me the emargination is lacking also.

Locality, Mount Moises, Isabella Province, Luzon, P. I., February, 1926 (R. C. McGregor).

It may be worth mention that in both the above species the fore femur has a series of short, stout bristles on the median portion of the posterodorsal surface which is duplicated centrally, instead of the usual single complete series of long bristles present in the other species.

Group LONGICORNIS

This group is distinguished by the very long antennae in the males, which extend almost to the level of the epistome, and the presence of short hairs on almost the entire length of the aristae. There are four well developed vertical bristles in both species, and the basal segment of the fore tarsus is slightly but quite noticeably thickened. In *longicornis* the arista is flattened, strap-like, but not very evidently widened.

EUPROSOPIA LONGICORNIS Bezzi

Euprosopia longicornis BEZZI, Philippine Journ. Sci., vol. 12, No. 3, sect. D, May, 1917, p. 154.

A small dark species with the wings more distinctly vittate than in most of the Philippine species. The third antennal segment in the male is broader than usual and deep black, and both sexes have yellow scale-like hairs on the abdominal tergites.

Locality, Sibuyan Island, P. I. (C. F. Baker).

The only other species of the group is *lepidophora* Bezzi.

Group MILLEPUNCTA

This group consists of those species in which the arista is haired on part or all of its extent, the antennae fall considerably short of attaining the level of the epistome, and the vertex has four well-developed bristles.

EUPROSOPIA MILLEPUNCTA Bezzi

Euprosopia millepuncta Bezzi, Philippine Journ. Sci., vol. 12, No. 3, sect. D, p. 152.

Quite similar to the preceding group in having the arista rather long haired on its entire extent, and the dorsum of the abdomen with many yellow scale-like hairs. But the antennae are much shorter, and the wings are very much more profusely infuscated, appearing dark with many small round hyaline spots, and two almost complete hyaline fasciae beyond middle bordering a fuscous fascia which is devoid of hyaline spots except on costal and posterior extremities.

Localities, Biliran, and Samar, P. I. (C. F. Baker).

EUPROSOPIA TRIVITTATA Bezzi

Euprosopia millepuncta Bezzi, Philippine Journ. Sci., vol. 12, No. 3, sect. D, May, 1917, p. 150.

A small species, distinguished from any in the Philippines by the dark brown mesonotum which is adorned with three greyish white dusted vittae, the central one extending over the disk of the scutellum, and the similarly marked abdomen, though in the latter only the central pale dusted vitta is distinct in the female, and the brown color is much reduced in the male, consisting usually of two incomplete vittae. The wings are largely pale brown, with many small hyaline dots, and not at all fasciate.

Neither sex has scale-like abdominal hairs, and the arista is long haired only on the basal third.

Locality, Mount Maquiling, P. I. (C. F. Baker).

Group NIGROPUNCTATA

Similar to the longifacies group, but the head is less than 1.5 as high as wide.

EUPROSOPIA NIGROPUNCTATA Hendel

Euprosopia nigropunctata Hendel, Abhand. k. k. Zool.-Bot. Gesellsch., Wien, vol. 8, Heft 1, 1924, p. 356.

Locality, Ceylon (Collection C. F. Baker).

Genus LAMPROGASTER Macquart

Lamprogaster MACQUART, Dipt. Exot., vol. 2, pt. 3, 1843, p. 211.

Up to the present but one species of this genus has been definitely recorded from the Philippines, but before me there are two species which are quite closely related though very different in coloration. I describe one of the species below as new to science.

It would appear worth mention that in all species from Australia which I have seen there is a well-developed bristle on the upper portion of the hind margin of the mesopleura and that in both the Philippine species this bristle is lacking. It is hardly necessary to erect a subgenus for the Philippine species on the basis of this character, but it will be of interest to note whether there are any species from any other region in which this bristle is absent normally.

LAMPROGASTER PLACIDA (Walker)

Chromatomyia placida WALKER, List Dipt. Brit. Mus., vol. 4, 1849, p. 802.

A deep metallic violet-blue species with black legs and hyaline wings, on the latter of which there are a few narrow black marks. Bezzi writes that the legs are entirely black but in some of the specimens there is a much paler, yellowish, portion at bases of the femora which may extend even to the middle. The wing markings consist of a partial fascia at apices of the basal cells, a slender oblique fascia from center of the stigma to or slightly beyond the inner cross vein, a narrow cloud on the outer cross vein, and opposite it on the costa a short spur of a fascia from the latter of which to apex of wing there is a narrow dark border. The frons is dull brownish or fuscous, the face, antennae, and labrum, testaceous yellow, and the palpi brownish.

All four verticals present but very short, ocellars undeveloped; antennae extending to slightly below middle of face and about as long as height of cheek; arista short haired to beyond middle, slightly compressed. Scutellum without discal hairs, with usually eight short marginal bristles and some fine hairs between them basally. First posterior cell narrowed apically; inner cross vein at about one-third from apex of discal cell.

Length, 8 mm.

Localities, Samar Island; Iligan, and Dapitan, Mindanao, P. I. (C. F. Baker). Bezzi recorded it from Butuan, Mindanao.

LAMPROGASTER FULVESCENS, new species

Female.—Fulvous yellow, frons brownish, labrum and apices of palpi black, legs fulvous yellow, fore tarsi and apices of mid and hind pairs dark brown; wings hyaline except for a brown cloud

along the costa from apex of auxiliary vein to apex of fourth, narrowed beyond apex of first vein and in apex of first posterior cell, a short spur from the costal streak extending over inner cross vein, and a narrow cloud on outer cross vein.

Structurally similar to *placida*, but larger, with the frons wider, the antennae a little longer, the scutellum with a more numerous short marginal bristles and hairs, and the aristae less evidently haired. The hairs on the thoracic dorsum are numerous, decumbent, and dark. In both species there is an indication of a weak apical central emargination of the scutellum, but it is apparently not constant.

Length, 10–11 mm.

Type.—Cat. No. 43076. U. S. N. M. Surigao, Mindanao, P. I., one paratype in rather poor condition, Basilan Island (C. F. Baker).

It must be noted that Walker's description does not fit the specimens identified as *placida* very well, but the specimens are of that species according to Bezzi's identification and redescription. If he is correct in his identification, then Walker's specimen must have been teneral as the thoracic color is given as ferruginous while in the specimens before me it is dark metallic green. The general color of *fulvescens* is nearer to that given by Walker for *placida*, but there are differences which prohibit one from accepting it as his species. Only a careful examination of the type specimen if it still exists will definitely decide the matter of its identity.

Genus PLAGIOSTENOPTERINA Hendel

Plagiostenopterina HENDEL, Abhand. k. k. Zool.-Bot. Gesellsch., Wien, vol. 8, 1914, pp. 7, 52.

This genus as accepted by Hendel contains species with very diverse structural characters. In his key to the genera of "Stenopterinina" he separates it from *Stenoptera* Macquart by the lack of frontoorbital bristles, and the apically narrowed first posterior cell of the wing. It falls in a section of his key along with *Icteracantha* Hendel and *Elassogaster* Bigot, from the first of which it can be separated by the unarmed femora, but it is difficult, or impossible, to readily separate it from *Elassogaster*, the only character he cites for that purpose being the oblique inner cross vein of the wing, *Elassogaster* having that vein erect. This method of separation is quite unreliable, and an examination of material available makes it evident to me that there are other characters of more significance, and more readily appreciable, available for group distinctions, but whether these are of generic value is of course a matter of opinion. I consider the segregates except *Elassogaster* as subgenera, and below I present a synoptic key for their separation based upon the characters above referred to. All of the included segregates will run down to *Plagiostenopterina* and *Elassogaster* in Hendel's generic key.

KEY TO THE SUBGENERA

1. Face with erect sparse microscopic hairs; occiput with a bristle behind post-ocular orbits a little above middle of eye; sides of postnotum above bases of halteres usually with fine but distinct erect hairs; no spiracle-like openings on the dorsal exposure of third and fourth visible tergites.
Plagiostenopterina Hendel, genotype **aenea** Wied.
Face entirely without hairs; postnotum without distinguishable hairs on sides ..... 2.
2. Third and fourth visible tergites in female each with a pair of spiracle-like openings on dorsal exposure; anterior margin of thoracic dorsum with four bristles; mesopleural bristle present.
Stenopterella, genotype **trivittata** Walker.
Third and fourth visible tergites without spiracle-like openings ..... 3.
3. Humeral and occipital bristles present; mesopleural bristle well developed.
Elassogaster Bigot, genotype, **metallicus** Bigot.
Humeral and occipital bristles lacking ..... 4.
4. Mesopleural bristle present ..... Bakeromyia, genotype, *calcarata* Macquart.
Mesopleural bristle lacking ..... Carolimyia, genotype, *diptera*, new species.

Subgenus PLAGIOSTENOPTERINA Hendel

The haired face, almost invariable presence of humeral and mesopleural bristles, and of hairs or pile on the basal section of the third wing vein, distinguish this subgenus from the others, but only the first-mentioned character is possessed by this group exclusively, one or more of the other characters recurring in the others.

Many of the species placed in *Plagiostenopterina* by Hendel are unknown to me, but I present below a key to those now before me in the hope that it may be useful to students of the family.

KEY TO THE SPECIES

1. Tarsal claws of the male with a very pronounced basal lobe, those of the female with a distinct basal angle; wings blackened, the costal, and central basal black stripes hardly darker than the remainder of the field.
samoaensis Malloch.
Tarsal claws in neither sex with either a basal lobe or distinct basal angle: wings hyaline, basal half of center of wing, and costa each with a conspicuous dark stripe ..... 2.
2. Scutellum, smooth, dusted, without punctures or short fine hairs on disk; humeral angles rather densely furnished with black hairs, the usual bristle very poorly or not at all differentiated ..... **parva**, new species.
Scutellum either granulose or with closely placed piliferous punctures, the hairs generally pale and fine and most readily seen when the surface is viewed from behind; humeral bristle always well developed ..... 3.
3. Mesopleural bristle lacking; hairs on aristae about three times as long as its basal diameter at base of third segment; mesonotum without trace of a central white dusted vitta; frons entirely dull, nowhere distinctly shining; section of costa between apices of first and second veins subequal to that between second and third; second visible abdominal tergite of female violet-black, densely brownish black haired on posterior lateral regions of dorsal exposure, and distinctly different in color from the other tergites which are metallic blackish blue; hind tarsi pale haired above; male without an apical palette ..... **formosae** Hendel.

Mesopleural bristle present; aristae without hairs, or much shorter haired than above; section of costa between apices of first and second veins distinctly shorter than that between second and third; frons usually partly shining; hind tarsi dark haired above posteriorly ..... 4.

4. Knobs of halteres pale yellow ..... 5.
Knobs of halteres dark brown or fuscous ..... 6.

5. Frons entirely shining, brownish red and without a dull black spot in center; African species ..... submetallica (Loew).
Frons shining, blackish brown, with a more or less evident violet tinge, and a dull black central spot on which the hairs are much darker and denser than elsewhere ..... dubiosa, new species.

6. Arista of male with an apical palette; frons almost all dull, with an opaque black central spot on the bluish central stripe; a small white tomentose triangle extending in front of anterior ocellus in both sexes; fourth tergite (third visible) in male about 1.5 as long as fifth ..... aenea (Wiedemann),
Arista of male without an apical palette; neither sex with a small white tomentose triangle in front of the ocelli; fourth tergite in male shorter than or but slightly longer than fifth ..... 7.

7. Frons almost entirely dull, with a central opaque black spot as in *aenea;* fourth tergite shorter than fifth in male ..... enderleini Hendel.
Frons entirely shining; fourth tergite slightly longer than fifth in male. westermanni Hendel.

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) AENEA (Wiedemann)

Dacus aenea WIEDEMANN, Zool. Mag., vol. 3, p. 29 (1819).

I am accepting Hendel's interpretation of this species as correct. It is not a difficult matter to identify the male because of its possession of an apical palette to the arista and the long fourth abdominal tergite, but the female is very similar to that of *enderleini.* In my specimens the white tomentose triangle in front of the ocelli is quite distinct and very different from the glossy similarly sized triangle of *enderleini.* It appears also that the fourth tergite is comparatively longer in contrast with the fifth in this species than it is in the other, but the abdomen of the female is subject to more expansion and contraction than is that of the male, so that one can seldom rely upon the comparative lengths of the tergites, at least those of the apical half.

Localities, Los Banos, Kolambugan, and Leyte, P. I. (C. F. Baker).

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) ENDERLEINI Hendel

Plagiostenopterina enderleini HENDEL, Abhand. Zool.-Bot. Gesellsch., Wien, vol. 8, p. 56 (1914).

Similar in size and general characters to *aenea*, differing as noted in the above paragraph.

Localities, Davao, Mindanao; and Mount Maquiling, Luzon (C. F. Baker).

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) SAMOAENSIS Malloch

Plagiostenopterina samoaensis MALLOCH, Insects of Samoa, Diptera, fasc. 5, p. 230 (1930).

This rather outstanding species is known only from the Samoan Islands. The tarsal claws and very dark wings readily separate it from any of its relatives.

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) FORMOSAE Hendel

Plagiostenopterina formosae HENDEL, Abhand. Zool.-Bot. Gesellsch., Wien, vol. 8, p. 56, 1914.

There is a specimen of this species, evidently a paratype, in the museum collection. The only locality known is Formosa.

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) DUBIOSA, new species

Similar in all respects to *aenea*, except in having the frons shining and with only the black spot dull, the arista of the male without a palette, the tomentose triangle in front of ocelli lacking, the fourth tergite of male shorter than the fifth, and no pale hairs on anterior portion of the third tergite in either sex.

Length, 8–10 mm.

Type.—Male. Cat. No. 43053, U.S.N.M. Allotype and three male paratypes, Singapore, Straits Settlements; paratypes, Colombo, Ceylon (Compere); and Mindanao, P. I. (C. F. Baker).

My first impression was that this might be *fasciata* Hendel, a Ceylonese species, but that has the frons without a dull black central spot, and the outer cross vein of the wing broadly clouded. The outer cross vein in the present species is very faintly clouded, almost imperceptibly so.

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) PARVA, new species

Female.—Very similar in general appearance to *aenea*, but smaller, with the thorax less evidently bluish, the mesonotum almost lacking punctures and the scutellum entirely without either punctures or fine discal hairs. The lower half of the face is shining black, the upper half whitish dusted, and the epistome more protruded in profile than in *aenea*, while the preocellar triangle is glossy though the remainder of the frons is much as in *aenea*. Though the humeral bristle is lacking on one side there is a slightly differentiated one amongst the numerous long hairs on the other, and it is possible that this bristle may sometimes be well developed.

Length, 6.5 mm.

Type.—Kaiserwilhelmsland (R. Schlechter). In the Deutsches Entomologisches Museum.

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) WESTERMANNI Hendel

Plagiostenopterina westermanni HENDEL, Abhand. k. k. Zool.-Bot. Gesellsch., Wien, vol. 8, p. 50, 1914.

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) SUBMETALLICA (Loew)

Stenopterina submetallica LOEW, Sitz. Akad. Berlin, p. 660 (1852).

The only distinction between the two specimens identified as the above species lies in the color of the halteres as indicated in the foregoing key to the species. As those with pale halteres are females and those with dark halteres are males it is not impossible that they are but the sexes of one species that are before me, but I do not care to suggest that the two species are synonyms on the basis of this material.

Locality, Lorenzo Marquez, Africa (C. W. Howard).

STENOPTERELLA, new subgenus

This subgenus is erected for the reception of three species in the collection, one of them new. The position of the spiracles on the fourth and fifth abdominal tergites of the female is sufficiently different from that of all other species that I feel justified in proposing a new subgenus for the group.

All three species which I place herein have the costal margin of the wing with a continuous narrow black border, and none of them have the narrow black central vitta on the wing which in all species of the subgenus *Plagiostenopterina* as limited herein extends to or beyond the inner cross vein. I present below a key to the three included species.

KEY TO THE SPECIES

1. Thoracic dorsum blue green, shagreened and not conspicuously vittate; coxae and femora black brown ..... **marginata** (van der Wulp).
   Thoracic dorsum black with a bluish tinge and with dense yellow dust, leaving only two black vittae on mesonotum; coxae and femora largely yellow ..... 2.
2. The two black thoracic vittae tapered posteriorly; abdomen with dense yellow dusted anterior margins to the tergites; spiracles on tergites 3 and 4 near to anterior margin ..... **trivittata** (Walker).
   The two black thoracic vittae not tapered except just at the posterior extremities, the central yellow dusted stripe equally distinct on its entire length; abdomen with but faint grey dusted anterior margins to the tergites; spiracles on tergites 3 and 4 situated near posterior margins. **trivittigera, new species.**

PLAGIOSTENOPTERINA (STENOPTERELLA) TRIVITTATA (Walker)

Dacus trivittata WALKER, List Dipt. Brit. Mus., pt. 4, p. 1072 (1849).

I have seen numerous specimens of this species from the Philippine Islands in the collection of the United States National Museum, most

of them from the Baker collection, and have one sent to me by Dr. Richard Frey from the same islands.

PLAGIOSTENOPTERINA (STENOPTERELLA) TRIVITTIGERA, new species

Female.—Similar to *trivittata* in general coloration, with the same very distinctly trivittate thoracic dorsum, and a continuous fuscous costal stripe. The two black thoracic vittae are, however, not tapered posteriorly except just at their extremities and the yellow central stripe is equally distinct on its entire length, the abdomen has no dense yellow dusted anterior margins to the tergites, the dust there being greyish and not at all dense, and the ground color is deeper metallic blue-green.

Structurally the species are very similar, both possessing the four bristles on the anterior margin of the thoracic dorsum, but there are numerous hairs on the scutellum besides the four bristles, while in *trivittata* only the bristles are present. The third and fourth tergites each have a pair of spiracular openings near the apex, one on each side at the lateral curve, whereas *trivittata* has the same organs near anterior margin, the pair on fourth tergite largest and separated by about four times the width of an opening, those on third tergite about half as large as those on fourth and separated by about twice that distance. The mid femur in this sex has a few weak bristles near the apex on the posterior surface in *trivittata* which are not evident in the type specimen of the new species.

Length, 8 mm.

Type, Singapore, Straits Settlements (C. F. Baker).

Type.—Cat. No. 41903, U.S.N.M.

PLAGIOSTENOPTERINA (STENOPTERELLA) MARGINATA (van der Wulp)

Stenopterina marginata VAN DER WULP, Tijd. v. Entom., vol. 23, p. 179 (1880).

This species differs from the preceding two in having the thoracic dorsum colored much as in *P. aenea* Wiedemann, and the legs much darker in color.

Locality, Mount Salak, Java.

It is possible that some of the other species placed by Hendel in *Plagiostenopterina* belong to this subgenus, but it is impossible to determine this without access to the species. There is one species very similar to *trivittata* Walker that may also find a place in the subgenus, having the same conspicuously vittate thorax, but the costal stripe is not continuous. This is *vittigera* de Meijere, described from Sumatra. No mention is made in the description of the latter, nor in that of any previously described species, of the presence of tergal spiracles in the females so that their subgeneric location is not possible from their descriptions alone.

CAROLIMYIA, new subgenus

This subgenus is distinguished readily from the others by the characters listed in the foregoing key. Both of the species which I place herein lack the occipital and mesopleural bristles, and have the scutellum with fine hairs and but two apical marginal bristles. The venation is much as in *Plagiostenopterina*, but the inner cross vein is almost erect and the central basal streak of black color is missing.

Genotype.—Carolimyia diptera, new species.

The two species accepted as belonging to the subgenus may be separated as below.

A [1]. Apical ventral spur of mid tibia blunt tipped; coxae, femora, and antennae, testaceous yellow; apex of wing in both sexes with a dark-brown mark from before level of outer cross vein to tip, in which there are some wedge-shaped pale marks (fig. 6) diptera, new species.

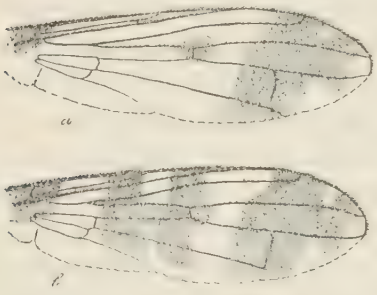

FIGURE 6.—WINGS OF PLAGIOSTENOPTERINA DIPTERA, *a*, FEMALE, *b*, MALE

FIGURE 7.—WING OF PLAGIOSTENOPTERINA PLAGIATA

A [2]. Apical ventral spur of mid tibia sharp tipped; legs and antennae fuscous, femora with metallic blue tinge; apex of wing with a fuscous cloud well beyond the level of outer cross vein in which there is one hyaline wedge-shaped incision in hind margin (fig. 7)----------plagiata (Bezzi).

CAROLIMYIA DIPTERA, new species

Male and female.—Head shining black, upper half of face testaceous yellow, parafacials, frontal orbits, and cheeks with white dust, the antennal foveae and pale upper portion of face yellowish dusted, occiput except the flattened upper third with dense silvery white dust; antennae testaceous yellow; aristae yellow at bases, black at apices; palpi fuscous; proboscis glossy black below. Thorax and abdomen metallic blue, mesonotum duller than the dorsum of abdomen because of the more numerous piliferous punctures; pleura with three vertical stripes of dense yellowish dust, one on propleura, the second over sternopleura, and the third on posterior portion of hypopleura and anterior portion of postnotum; the abdomen without dust, black haired. Legs testaceous yellow, tibiae blackish brown, tarsi black. Wings hyaline, with blackish-brown marks as in Figure 6. Calyptrae whitish gray. Halteres yellow.

Frons longer than wide, slightly wider in male, orbits very narrow, ocellars not developed; verticals four; antennae extending to about

two-thirds of the face length; aristae distinctly haired to beyond middle, the longest hairs fully half as long as width of third antennal segment; face projecting from middle to epistome; foveae deep; labrum higher than width of third antennal segment, palpi as wide as latter. Thorax without distinct anterior marginal, humeral, and mesopleural bristles; lower posterior angle of hypopleura with microscopic soft hairs. Fourth visible abdominal tergite about twice as long as third in male, about 1.5 as long in female. Legs without exceptional armature; fore tarsus slightly dilated apically in both sexes.

Length, 10–11 mm.

Type.—Male, Cat. No. 43066, U.S.N.M. Allotype, and one male and three female paratypes, Montalban, Luzon, P. I. (C. F. Baker); two male paratypes, Dilang, Cavite, P. I. (R. C. McGregor).

The subgenus is named in honor of the late C. F. Baker.

CAROLIMYIA PLAGIATA (Bezzi)

Elassogaster plagiata Bezzi, Philippine Journ. Sci., vol. 12, sec. D, p. 135 (1917).

The female example in the Museum collection is apparently much less conspicuously marked on the wings than was the type female described by Bezzi, but by turning the wing to a certain angle the large dark mark in front of the outer cross vein may be faintly distinguished. I figure the wing, as should the form now before me be the normal one it would be difficult for anyone to identify it from the description alone (fig. 7).

Structurally the species is very similar to *diptera*, but the sharp tipped apical spur of the mid tibia and the presence of a few fine erect hairs on the supraspiracular convexity of the postnotum will readily distinguish it if taken in conjunction with the duller blackish-blue color of the thorax and abdomen and the wing markings.

Length, 11 mm.

Locality, Mount Maquiling, Luzon (C. F. Baker).

The Museum specimen bears a number, "3923," indicating that it was one of a pair, the other being sent to Bezzi.

Bakeromyia, new subgenus

In addition to the characters listed in the key for the distinction of this subgenus from its allies it may be worth mention that there are always two quite well-developed bristles on the outer side of each hind coxa, while in the preceding subgenus there is either one or none. For other characters see the descriptions of species below.

Subgenotype.—Bakeromyia calcarata (Macquart).

The four species which I place in the subgenus may be distinguished as below.

KEY TO THE SPECIES

1. Wing with a blackish fascia the inner margin of which runs along the outer cross vein, the fascia becoming paler as it leaves the cross vein and disappearing before attaining the apex of wing; inner cross vein with a conspicuous spot like brown or fuscous cloud; legs almost entirely testaceous yellow ..... **discolor**, new species.

   Wing without a broad preapical fascia, always with a narrow blackish costal stripe on entire extent which is widened slightly at apex; legs fuscous or black ..... 2.

2. Male with a long strong apically tapered spine on hind trochanter which is about half as long as the basal segment of hind tarsus; spot on inner cross vein large and conspicuous ..... **calcarata** (Macquart).

   Male without a conspicuous spine on the hind trochanter; spot on inner cross vein narrow and inconspicuous ..... 3.

3. Male with a short wartlike protuberance on the inner side of each hind trochanter near apex; short hairs on posterior central portion of mesonotum yellow; face and labrum testaceous yellow ..... **armata**, new species.

   Male without any indication of a protuberance on inner side of hind trochanter; mesonotal hairs black; face and labrum black. **inermis**, new species.

NOTE.—The females of *armata* and *inermis* are unknown to me, and for this reason I base my key to these and *calcarata* upon the male sex alone.

PLAGIOSTENOPTERINA (BAKEROMYIA) CALCARATA (Macquart)

Herina calcarata MACQUART, Dipt. Exot., vol. 2 (3), p. 207 (1843).

This species is evidently not uncommon in the Philippine Islands and there are a number of examples in the Baker collection in the United States National Museum. The general color is bright metallic blue, sometimes with a violet sheen, the wings are hyaline, with a deep black costal stripe on the entire extent from base to apex of costal vein, which is widened basally to cover the fork of second and third veins, then confined to the subcostal cell, a narrow margin of marginal cell, and slightly widened over apex of first posterior cell; inner cross vein with a quite large spotlike black mark, outer one with a similar, but rather narrower, black mark; legs black. The male is readily distinguished by the hind trochanteral spur, but the female lacks this and except for the broader clouding of the cross veins must be very similar to the females of *armata* and *inermis* which are unknown to me.

PLAGIOSTENOPTERINA (BAKEROMYIA) ARMATA, new species

Male.—Very similar in coloration to *calcarata*, but the face, palpi, and labrum are not blackish, their general color being pale testaceous yellow, and the dark marks on the wings are narrower except in the case of the costal streak which is more noticeably widened in the apex of first posterior cell.

Structurally the species are very similar, the principal distinction lying in the armature of the hind trochanters which in the present species consists in the male of a short wartlike protuberance on the inner surface near the apex, furnished to tip with fine pale hairs.

Length, 10 mm.

Type.—Male, Cat. No. 43068, U.S.N.M. Tangcolan, Bukidnon, P. I. (C. F. Baker).

PLAGIOSTENOPTERINA (BAKEROMYIA) INERMIS, new species

Female.—Similar to *calcarata* in general coloration, differing in the same manner as *armata*, in so far as wing markings are concerned, except that the costal streak is less widened at apex; the face is blackish or fuscous, and the mesonotal hairs black.

The only outstanding structural distinction appears to be that there is no indication of a process on the inner side of the hind trochanters. The specimen is a little abnormal in having a slight protuberance on one of the mid trochanters, but this may be disregarded.

Length, 13 mm.

Type.—Cat. No. 43067, U.S.N.M.. Biliran, P. I. (C. F. Baker).

PLAGIOSTENOPTERINA (BAKEROMYIA) DISCOLOR, new species

Male and female.—Radically different from the other three species in the wing markings, which rather closely resemble those of the female of *Carolia diptera*, from which it differs in having the inner margin of the preapical black mark extending in a straight line from before the apex of second vein to hind margin of wing very slightly proximad of the outer cross vein, in having no wedge-shaped hyaline marks on the margin of wing in the black mark, the latter fading out gradually toward tip of wing. Head fuscous; frons brown, interfrontalia shining above bases of antennae; antennae and palpi testaceous yellow, sometimes browned in the male; face generally testaceous yellow, sometimes more or less stained with brown. Thorax black, slightly bronzy, without distinct dorsal vittae, the mesonotum rather evenly grayish dusted except on lateral margins. Abdomen bright metallic blue or blue-green. Legs varying from testaceous yellow to tawny yellow, fore tibiae brown, fore tarsi and apices of mid and hind pairs fuscous or black.

Structurally similar to *inermis*, the hind trochanters unarmed in the male, and the inner cross vein is more distinctly beyond the middle of the discal cell.

Length, 9–11 mm.

Type.—Male, Cat. No. 43069, U.S.N.M. One male paratype, Tangcolan, Bukidnon, P. I.; allotype and one female paratype, Davan, Mindanao, P. I. (C. F. Baker).

In all four species the scutellum has minute discal hairs and four subequal marginal bristles.

Genus ELASSOGASTER Bigot

Elassogaster Bigot, Ann. Soc. Ent. France, p. 546 (1859).

This genus is distinguished from *Plagiostenopterina* Hendel by the lack of hairs on the face, the comparatively longer first basal cell with its erect cross vein at apex, the upward rather than downward deflection of apex of third vein, and the entire absence of hair or pile from the upper surface of the section of fifth vein between the basal cells.

I have before me two species of the genus, neither of them the genotype.

ELASSOGASTER SEPSOIDES (Walker)

Dacus sepsoides Walker, Proc. Linn. Soc., vol. 5, p. 163 (1861).

A common species throughout the Orient. A synonym of this species is *P. hendeli* Knab.

Many specimens in United States National Museum collection from the Philippines, mostly from the Baker collection, and the type series of *hendeli* Knab.

ELASSOGASTER VANDERWULPI Hendel

Elassogaster vanderwulpi Hendel, Abhandl. Zool.-Bot. Gesellsch., Wein, vol. 8, p. 83 (1914).

I have examined two specimens of this species from Southern Rhodesia. It is in nearly all respects similar to the preceding species, but the tarsi of all legs are deep black, and the apical black spot on the wing is smaller; the mid and hind tarsi in *sepsoides* are reddish.

ELASSOGASTER TERRAEREGINAE Malloch

Elassogaster terraereginae Malloch, Proc. Linn. Soc., N. S. W., vol. 53, p. 352 (1929).

This Australian species differs from the preceding two in having the apical dark spot of the wing reduced to a narrow stripe along the margin beyond the apex of the second vein, the legs honey-yellow with the fore tibiae and tarsi deep black, and the central grey dusted mesonotal vitta undivided posteriorly and continued on to base of scutellum.

The fourth wing vein is less noticeably curved forward at apex, ending behind the tip of the wing, and the disk of the scutellum is not bare but furnished with a number of pale hairs. The frons is also broader and distinctly punctured.

ELASSOGASTER PLAGIATA Bezzi

Elassogaster plagiata Bezzi, Philippine Journ. Sci., sect. D, vol. 12, p. 135 (1917).

This species does not belong to *Elassogaster* on the basis of an example in the Baker collection in the National Museum. It has been removed to a subgenus of *Plagiostenopterina.*

ELASSOGASTER HYALIPENNIS, new species

Female.—Head fuscous, frons almost black, not shining, narrowly testaceous on each side, face clay yellow, dark brown in foveae and below them, parafacials and cheeks yellowish brown, labrum and palpi testaceous yellow, occiput and frontal orbits rather densely pale grey dusted, parafacials and cheeks not so much dusted; antennae brownish yellow, third segment darker above. Thorax black, with a distinct bronzy tinge, the mesonotum greyish dusted, slightly matted in type but evidently without outstanding vittae, the mesonotal hairs very short and dark, those on the pleura pale. Abdomen black, with very pronounced bronzy or greenish luster, the hairs mainly yellowish. Legs tawny yellow, fore coxae and fore tibiae slightly browned, fore tarsi and apices of mid and hind pairs dark brown. Wings hyaline, without distinct dark apical spot. Calyptrae and halteres orange yellow.

Frons about 1.5 as long as wide, sides slightly undulated, four verticals present, ocellars lacking; antennae slender, extending to lower fourth of face in center, the third segment longer than height of cheek, aristae distinctly pubescent at bases; labrum about twice as high as width of third antennal segment; occipital bristle well developed. Thorax with the same bristles as in *sepsoides* Walker. Fourth visible tergite about as long as the preceding two combined, the surface almost without punctures. Legs normal, fore tarsus hardly dilated, hind femur without anteroventral bristles but with about three anterodorsal bristles apically. Wing venation differing from that of the other species recorded above in having the third vein very slightly bent down at apex; inner cross vein almost erect; penultimate section of fourth vein about four-fifths as long as ultimate one.

Length, 8.5 mm.

Type.—Female, Cat. No. 43065, U.S.N.M. Baguio, Benguet, P. I. (C. F. Baker).

This is the only species of the genus known to me in which there is no apical or discal dark marks on the wings.

Genus SCELOSTENOPTERINA Hendel

Scelostenopterina HENDEL, Abhand. k. k. Zool.-Bot. Gesellsch., Wien, vol. 8, p. 86, 1914.

This genus is very similar to *Plagiostenopterina* Handel, and was distinguished therefrom by its author by the thickened, spindle-shaped femora. He did also mention that the thorax was narrowed in front, but there is no distinction between the thorax and that of typical Plagiostenopterinae before me, and I infer that the poor condition of his single example of his genotype was responsible for his assumption that the shape was different. I have very carefully examined a number of specimens of the genotype in good condition in the United States National Museum collection and find that in most characters it agrees well with *Plagiostenopterina*, having the hind coxae haired at apices above, the humeral and mesopleural bristles present, a well developed occipital bristle, four verticals, the aristae short haired basally, and the wing venation almost as in *aenea* Wiedemann. It differs, however, in having the femora all thickened, the fore pair in the male with a short wart-like protuberance near apex on the posteroventral surface, the face bare, and the lateral portions of the postnotum with even more noticeable erect fine hairs than in typical species of that genus.

SCELOSTENOPTERINA FEMORATA Hendel

Scelostenopterina femorata HENDEL, Abhand. k. k. Zool.-Bot. Gesellsch., Wien, vol. 8, p. 86, 1914.

Very similar in general color and habitus to *Plagiostenopterina aenea* Wiedemann, the wings hyaline with a narrow costal stripe, and a central one extending from base to the inner cross vein, fuscous, as in that species.

The abdomen in the male has rather dense erect fine pale hairs on the tergites, and the first visible tergite has from two to four long black bristles in a vertical series on each side. The color of the legs is rather variable, the fore and mid pairs sometimes being largely or entirely fulvous yellow and sometimes dark brown.

Locality, Mount Banahao, P. I. (C. F. Baker).

This is evidently some of the same material as was recorded by Bezzi in 1917.[1]

It is to be noted that the postnotal hairs in this species are on the upper anterior triangular portion, not on the central posterior portion as in *aenea* Wiedemann.

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[1] Philippine Journ. Sci., vol. 12, sec. D, p. 136.

MINDANAIA, new genus

This genus will run down to *Stenopterina* Macquart in Hendel's key to the genera of this group, possessing a narrowed first posterior cell and one well-developed orbital bristle on each side of frons. A comparison of the genotypes, however, discloses the fact that that of the new genus has many fine erect black hairs on the upper lateral triangular section of the postnotum which are lacking in *Stenopterina*.

Genotype.—Mindanaia latifasciata, new species.

MINDANAIA LATIFASCIATA, new species

Female.—Head fuscous, frons dark brown, paler anteriorly and narrowly along eye margins, upper orbits shining black; face glossy blackish brown below, white dusted on upper half; antennae and palpi fuscous, basal segments of former paler. Thorax and abdomen black, with but slight indications of bluish tinge, dorsum of former with grey dust forming faintly indicated vittae anteriorly, the central one rather broad and the most distinct. Abdomen largely glossy, slightly grey dusted on sides of the basal two segments; hairs pale. Legs fuscous, yellowish at bases of hind femora, apices of mid tibiae, and on basal two segments of mid and hind tarsi. Wings hyaline, with fuscous marks as in Figure 8. Halteres yellow.

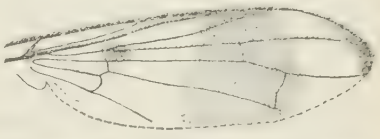

FIGURE 8.—WING OF MINDANAIA LATIFASCIATA

Frons over twice as long as wide, unpunctured, four verticals well developed, occelars microscopic; antennae extending about four-fifths of the distance to epistome, third segment narrowed apically; arista with the upper hairs about half as long as the width of third antennal segment, the lower hairs shorter; occipital bristle present; face shallowly foveate on sides; labrum higher than width of third antennal segment. Lateral anterior marginal bristles present on dorsum of thorax, humeral and mesopleural present: scutellum with discal hairs and four marginal bristles. Fourth visible tergite about 1.5 as long as third. Legs normal, mid tibia with one apical ventral bristle. Wing venation as Figure 8, first and third veins setulose to apices, fifth vein bare.

Length, 6.25 mm.

Type.—Female, Cat. No. 43060, U.S.N.M. Zamboanga, Mindanao, P. I. (C. F. Baker).

Genus PSEUDEPICAUSTA Hendel

Pseudepicausta HENDEL, Abhand. k. k. Zool.-Bot. Gesellsch., Wien, vol. 8, p. 112, 1914.

This genus superficially resembles *Plagiostenopterina* Hendel, but the ultimate section of the fourth wing vein is never curved forward

apically, so that the first posterior cell is not at all narrowed in the apex of the wing; and the lower posterior angle of the metapleura, and the hind coxae at apices above, are without hairs.

The genotype is *Herina chalybea* Doleschall. Before me there are four other species besides the genotype, data upon which are presented below.

PSEUDEPICAUSTA CHALYBEA (Doleschall)

Herina chalybea Doleschall, Natur. Tijd. v. Ned.-Ind., vol. 17, p. 125 (1858).

A metallic blue species, with a large fuscous mark on the apex of the wing the inner margin of which extends from the costa about midway between apices of first and second veins obliquely to margin beyond the tip of fourth vein, a dark costal streak, most intense in the subcostal cell, and dark clouds on the outer and inner cross veins least conspicuous on the latter.

The vertex has but two strong bristles, the scutellum has six bristles, the two near base and two on disk shorter than the apical pair; and the mesopleural strong.

Locality, Manila, P. I., December, 1924 (R. C. McGregor).

PSEUDEPICAUSTA ANGULATA Hendel

Pseudepicausta angulata Hendel, Abhand. k. k. Zool.-Bot. Gesellsch., Wien, vol. 8, p. 118, 1914.

This species is very similar to the genotype, but the wing markings differ in that the apical fuscous mark is carried less distinctly behind the third vein at apex, the costal streak is not appreciably paler between apex of first vein and inner edge of the apical mark, and there is a fuscous cloud along the fourth vein connecting the two clouds on the inner and outer cross veins.

Structurally the species differ in the armature of the vertex, *angulata* having four bristles, the additional pair being central and cruciate. Both species have an occipital bristle, and the third antennal segment extending to below level of epistome.

Locality, Penang (C. F. Baker).

PSEUDEPICAUSTA BATAVIENSIS (Schiner)

Stenopterina batavicnsis Schiner, Reise d. Novara, Diptera, p. 288 (1868).

I have seen one female of this species. It has much the appearance of *angulata*, but the cross veins are but slightly clouded, the clouds are not connected along the fourth vein, the frons is much more narrowed at vertex, and the second and third abdominal tergites are white dusted at apices. The four vertical bristles are well developed, and there are no distinct orbitals; scutellum with six bristles, one pair on disc a little smaller than the others.

Locality, Wai Lima Z., Sumatra, 1921 (Karny and Siebers).

In author's collection.

PSEUDEPICAUSTA COMPLETA, new species

Female.—Head fuscous, frons brownish, frontal orbits with dense whitish dust, narrowed posteriorly, face testaceous yellow, darker in the foveae, labrum and palpi concolorous with face; antennae slightly darker than face, third segment brownish except at base; aristae testaceous yellow; parafacials, cheeks, and postocular orbits, densely whitish grey dusted. Thorax metallic blackish green, densely grey dusted, the mesonotum with four black vittae, two on the dorsocentral areas and two, less distinct, on the notopleural sutures; scutellum grey dusted. Abdomen brighter metallic blue-green than thorax, less densely grey dusted. Legs black. Wings hyaline, with a deep black costal margin which extends to second vein on its entire extent, inner outline leaving a short distance before apex of that vein and running diagonally across wing to slightly behind apex of fourth vein, the inner margin all sharply limited; veins yellow basally, becoming darker apically except in the dark costal area where they are entirely black. Calyptrae and halteres pale. Hairs on frons, mesonotum, and most of the femora pale.

Frons at vertex about one-third of the head width, not appreciably widened anteriorly, with quite dense soft erect hairs, orbits conspicuously differentiated because of their dense whitish grey dusting, each with two short bristles near upper extremity; all four verticals present; ocellars short but distinct; the orbital hairs descending a little below the bases of antennae on parafacials; aristae distinctly pubescent; antennae extending to below level of epistome; labrum not as high as width of third antennal segment; palpi slightly widened apically. Thorax with fine decumbent dorsal hairs; two presutural bristles immediately behind head, the acrostichal pair lacking, notopleural bristle sometimes very short and duplicated, the mesopleural short; scutellum with four bristles. Abdomen without black bristles on sides of first visible tergite. Legs of normal build, fore femur with a series of posterodorsal and a partial series of posteroventral bristles; hind tibia with three or four very fine setulae centrally on anteroventral surface; third wing vein very slightly bent down apically; outer cross vein at almost twice its own length from inner.

Length, 6.5–7 mm.

Type and four paratypes, Cairns, N. Queensland, Australia (coll. Lichtwardt, Deutsches Entomologisches Institut.).

Paratype.—Female, Cat. No. 43071, U.S.N.M. Deposited in the collection of the United States National Museum through the kindness of Dr. Walther Horn.

PSEUDEPICAUSTA ATTENUATA, new species

Female.—Very similar to the next preceding species, agreeing with it in all respects except as follows: The scutellum has six marginal

bristles, the black costal stripe is not uniformly colored, being yellowish in the costal cell, and in the submarginal cell except at extreme apex, so that the vitta may be said to be attenuated before apex of the auxiliary vein and beyond that of the first vein; the outer cross vein is at little more than its own length from the inner; and the anteroventral setulae on central portion of the hind tibiae are rather stronger. The specimens of both species are not in the best of condition, but it appears to me that the third antennal segment in the present species is shorter than in *completa*, and the arista is a little more noticeably haired.

The two examples before me have the posterior notopleural bristle duplicated, both being quite strong and short.

Length, 7 mm.

Type and one paratype.—Cairns, N. Queensland, 1907, same collection as *completa.*

Family HELOMYZIDAE

My interpretation of this family is wider than that of Dr. F. Hendel in his most recent treatment of the Palearctic Diptera,[2] including as it does the group he designates as Trichoscelidae, ranking the latter as a separate family. I do not care to accept the latter as even a subfamily, as with all available material it appears to me that the two merge into each other, no one character being of invariable dependability in their separation. I have just finished a revision of a portion of the family as represented in New Zealand which corresponds quite closely with the genus now dealt with below, and in a previous paper with A. L. Tonnoir described several genera and subgenera which have a very similar appearance but are rather clearly connecting links between the present group and the larger and more northern representatives generally accepted as Helomyzidae.[3] Usually the genus *Trixoscelis* Rondani has been considered as distinct from *Diastata* Meigen, but they have the same genotype, *obscurella* Fallen, and are thus identical. I have examined the genotype and find that in but two characters of any importance does it differ from the genotype of *Spilochroa* Williston. Of these but one is structural, the much higher cheek, while the other consists of the maculated wings, *obscurella* and its closest allies having the wings either hyaline or partly clouded. It appears worthy of note that Hendel has described a characteristic *Spilochroa* under the generic name *Trichoscelis*, as shown in the following pages. I confine the present paper to a treatment of those species with dark spotted wings and narrow cheeks as shown in the following specific key.

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[2] Die Tierwelt Deutschlands, etc., part 2, Diptera, General Treatment, 1928.

[3] Rec. Cant. Mus., vol. 3, p. 88 (1927).

Genus DIASTATA Meigen

KEY TO THE SPECIES

1. Wings fuscous, with numerous hyaline spots, or hyaline with numerous small dark spots; cheeks less than one-sixth of the eye height (Subgenus Spilochroa Williston)----2.

   Wings hyaline, sometimes partly clouded with brown, never with clear-cut pale or dark spots; cheek much over one-sixth of the eye height (Subgenus Disastata Meigen).

2. Subcostal cell of wing with a small dark spot in center, or largely brownish-3.

   Subcostal cell of wing entirely whitish hyaline----5.

3. Mesonotum grey dusted, and with three brown vittae, the laterals along the lines of dorsocentrals, all three united posteriorly; thorax and abdomen dark brown below and on sides, the dark color extending narrowly along the dorsal edges of abdominal tergites, and each tergite with a central brown mark on a grey dusted ground; subcostal cell of wing almost entirely fuscous, darkest in center----**dimidiata** (Hendel).

   Mesonotum grey dusted, but without well-defined vittae; thorax and abdomen not colored as above; subcostal cell whitish hyaline, with a small dark central spot----4.

4. Abdomen dull chocolate brown, with numerous irregular grey dusted spots on tergites; discal cell of wing dark brown, with two or three hyaline spots in the apical half which are sometimes partly fused, and at least one smaller spot near the base----**ornata** (Johnson).

   Abdomen glossy, varying in tone from black to yellowish with blackish apices to the tergites; discal cell of wing dark brown, with a hyaline spot beyond its middle----**polita**, new species.

5. Scutellum dark brown, with a pale grey dusted spot at apex and one on each side at base; wings black-brown, the marginal cell with two large hyaline spots beyond apex of first vein dividing the cell into three almost equal parts, and sometimes a faint additional pale spot at its apex.

   peruviana, new species.

   Scutellum pale grey dusted, entirely without brown markings----6.

6. Wings black-brown, with small clear-cut hyaline spots, three of them in the marginal cell, the second posterior cell with four hyaine spots; prescutellar acrostichal bristles lacking----**albibasis**, new species.

   Wings hyaline, with the dark markings much reduced and not sharply margined, the marginal cell with three diffuse dark marks, and the second posterior cell with three, one in center, one at apex, and one at base along the inner cross vein; prescutellar acrostichal bristles present but weak.

   punctipennis (Melander).

DIASTATA (SPILOCHROA) DIMIDIATA (Hendel)

Trixoscelis dimidiata HENDEL, Deutsch. Ent. Zeitschr., 1913, p. 617.

I have not seen this species, but the description includes details on the structure of the head and thorax, and the photographic figure of the wing is so clear that there can be no question as to the generic location of the species. The color markings of the thorax and abdomen readily distinguish it from any other species known to me and also from *Diastata chilensis* Schiner,[4] the latter not being included in

[4] Novara Reise, Diptera, p. 235, 1868.

the foregoing key, though it is readily distinguished from any included species by the color markings of the wings and body.

DIASTATA (SPILOCHROA) PUNCTIPENNIS (Melander)

Spilochroa punctipennis MELANDER, Psche, vol. 20, p. 167 (1913).

I have examined only the two examples in the United States National Museum which belong to the type series.

Known only from New Mexico.

DIASTATA (SPILOCHROA) ORNATA (Johnson)

Heterochroa ornata JOHNSON, Proc. Philadelphia Acad. Nat. Sci., 1895, p. 306.

This is the commonest of the North American species, but it has been recorded only from Florida and the West Indies. Before me there are specimens from Texas which agree very well with those from Florida, but the two which I have examined from Kingston, Jamaica, differ from both in having the two larger hyaline marks in the marginal cell of the wing connected posteriorly, and three instead of two smaller hyaline marks directly below them in the submarginal cell. There is also a rather evident brown mark in center of the posterior margin of the mesonotum which is not, or but slightly, visible in the Floridan specimens. It is not improbable that this is a distinct species from *ornata*, but more material is necessary to enable dissection of the male hypopygium to insure a definite decision.

DIASTATA (SPILOCHROA) POLITA, new species

Female.—Differs from *ornata* in having the mesonotum without small brown marks, the scutellum with two faint brownish marks at apex, the abdomen usually glossy black or very dark brown, rarely with the bases of the tergites yellowish, and the wings with less numerous hyaline markings.

Structurally similar to *ornata*.

Length, 3–3.5 mm.

Type.—Cat. No. 43124, U.S.N.M., New Mexico, airplane (P. Glick). Paratypes, Las Cruces, N. Mex. (Townsend), and Texas (Belfrage).

The Texan specimen is the one with pale colored abdomen.

DIASTATA (SPILOCHROA) ALBIBASIS, new species

Male.—Head similar to that of *ornata*, the thorax with paler grey dusting and a dark brown dot at base of each of the dorsocentral bristles, the abdomen whitish grey dusted at base above, merging into dark brown before middle, the apex almost black, the hypopygium alone shining. Wings whitish hyaline, unspotted to level of apex of first vein except for a mark over humeral cross vein, markings on disk much as in *ornata*. Legs testaceous yellow. Halteres yellow.

Structurally similar to *ornata*, but there are no prescutellar acrostichals in the type specimen.

Length, 3 mm.

Type.—Cat. No. 43126, U.S.N.M. From near Ledoux, N. Mex., August 21 (T. D. A. Cockerell).

DIASTATA (SPILOCHROA) PERUVIANA, new species

Male and female.—Quite similar to *ornata* in general coloration, but the lack of a dark mark in the costal cell of the wing, the differently marked scutellum, the tripunctate appearance of the tergites of the apical two-thirds of the abdomen, and the rather different wing markings are sufficient to distinguish the species. The abdomen is grey dusted and beyond the basal two tergites there are usually three dark brown spots on each, with some miscellaneous dark dots, the second tergite having the dark markings confined to the apex in the form of a ragged apical fascia. The mesonotum has some brownish marks on center of disk and a brown dot at base of each of the larger bristles. Legs fuscous, apices of the tibiae, and the tarsi, yellowish.

Structurally similar to *ornata*, but possibly presenting distinctions in the male hypopygium which I have not dissected.

Length, 3 mm.

Type.—Cat. No. 43125, U.S.N.M. Female, Verrugas Canyon, Lima, Peru, March 23, 1923; allotype, topotypical, June 20, 1928; paratype, topotypical, June 20, 1928 (R. C. Shannon).

Family PERISCELIDAE

I have already given a revision of this group [5] in so far as the genera are concerned and now add an additional genus, bringing the total now known to five. I rather incline to hold my previous opinion regarding the status of this group, as a subfamily of Sapromyzidae, but there are some characters possessed by the new genus which cause me to hesitate in definitely expressing myself on the point at this time and I tentatively accept Hendel's decision.

MARBENIA, new genus

This genus is readily distinguished from any one of the already described four genera by the wing venation, the costal vein ceasing at apex of third vein, and the vein at apex of anal cell being but faintly indicated. In addition to these characters the face has a distinct depression below bases of the antennae and three transverse depressions below that, the central one of which has on each side an upwardly curved bristly hair. (Fig. 9.) In my previously published key to the genera in the paper above referred to I divided the group into two segregates, one with the auxiliary vein without any indica-

[5] Proc. U. S. Nat. Mus., vol. 68, art. 21, p. 24 (1926).

tion of a forward curvature at apex and the face conspicuously protruded below, and the other with a distinct forward curvature of the auxiliary vein at apex, and the face not conspicuously protruded below. The present genus has no forward curvature of the apex of the auxiliary vein (fig. 10), and the face though more or less protruded is transversely wrinkled or furrowed (fig. 9).

Genotype.—Marbenia peculiaris, new species.

This genus is dedicated to Dr. Marcus Benjamin, editor of these Proceedings, as a mark of respect by the author.

MARBENIA PECULIARIS, new species

Female.—Head shining testaceous yellow, lower half of face fuscous, central portion of frons and upper occiput yellowish brown; antennae deep black, third segment testaceous yellow; aristae fuscous; palpi fuscous, frontal

FIGURE 9.—MARBENIA PECULIARIS. LEFT, HEAD FROM THE SIDE; RIGHT, HEAD FROM IN FRONT (INCOMPLETE)

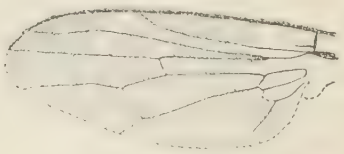

FIGURE 10.—MARBENIA PECULIARIS, WING

and facial orbits white dusted. Thorax brownish black, dorsum darkest and with slight whitish grey dust, not vittate; humeral angles and the scutellum testaceous yellow. Abdomen blackish brown, unmarked. Legs fuscous, tibiae each with a narrow annulus beyond middle and the extreme apex testaceous yellow, basal three segments of all tarsi yellow. Wings rather evenly infuscated, with yellowish white hyaline markings as in Figure 10, the veins on pale parts yellowish, on other parts dark. Calyptrae and halteres yellow.

Head in profile and from in front as in Figure 9. Thorax with two pairs of postsutural dorsocentrals and no acrostichals, the surface hairs fine and short; scutellum bare on disc, with four marginal bristles. Legs normal, mid tibia with a well developed apical ventral bristle, no preapical dorsal bristle evident on any pair. Venation as in Figure 10.

Length, 3.5 mm.

Type.—Cat. No. 43127, U.S.N.M. Portobello, Panama, March, 1911 (A. Busck).

U. S. GOVERNMENT PRINTING OFFICE: 1930

REPORT ON THE SOUTH AMERICAN SEA STARS COLLECTED BY WALDO L. SCHMITT

By W. K. Fisher

Of the Hopkins Marine Station, Pacific Grove, Calif.

The following list of sea stars is based upon material collected by Dr. Waldo L. Schmitt, of the United States National Museum, in 1926 and 1927, during an extended investigation of the higher crustacea of South America, made under the auspices of the Walter Rathbone Bacon scholarship. General collecting was therefore incidental to the main object of the expedition. The principal localities are: Salaverry and Talara, Peru; Antofagasta, Tocopilla, and Punta Arenas, Chile; the Juan Fernandez Islands; Port Stanley, Port William, and Teal Inlet, Falkland Islands; Deseado, Patagonia.

Especially valuable and perplexing has been a series of *Anasterias* from the Falkland Islands. *Ophidiaster agassizii* is figured for the first time.

OPHIDIASTER AGASSIZII Perrier

Plates 1 and 2; text Figure 1

Ophidiaster agassizii Perrier, Bull. Mus. Comp. Zoöl., vol. 9, 1881, p. 10; Mém. sur les Etoiles de Mer, 1884, p. 223.—Meissner, Archiv f. Naturgesch., 1896, vol. 1, p. 99.—de Loriol, Revue Suisse de Zoöl., vol. 8, 1900, p. 79.—Lieberkind, Asteroidea, in: The Natural History of Juan Fernandez and Easter Island, edited by Dr. Carl Skottsberg, vol. 3, 1920, p. 387.—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 83.

Juan Fernandez, December 9, 1926, two specimens.

Clark (1921) writes that this species is related to *O. confertus* of Lord Howe Island and *O. kermadecensis* of Raoul Island, Kermadecs, but is perfectly distinct from both. These species belong to the section of the genus characterized by having between the furrow spinelets one or more granules on the inner surface of the furrow, and only one madreporite. Clark writes that the papular pores are numerous (10 to 20 in each area), but in these examples of *agassizii* (R, 27 mm.), there are only 5 or 6. Many of the furrow spinelets are without intervening granules. On the proximal half of the ray

there is a characteristic pedicellaria in, or bordering, most of the papular areas: distally they are much less numerous than proximally (text fig. 1).

CYCETHRA VERRUCOSA (Philippi)

Goniodiscus verrucosus PHILIPPI, Archiv f. Naturgesch., 1857, p. 132.
Cycethra verrucosa MEISSNER, Zoöl. Anz. 1898, p. 394.—KOEHLER, Astéries et Ophiures, Further Zoological Results of the Swedish Antarctic Expedition 1901–1903, vol. 1, No. 1, 1923, p. 60, pl. 7, figs. 5, 11, 12, 13; pl. 8, figs. 3–9.

Port Stanley, Falkland Islands, three specimens. Near Teal Inlet, Falkland Islands, one specimen, March–April, 1927.

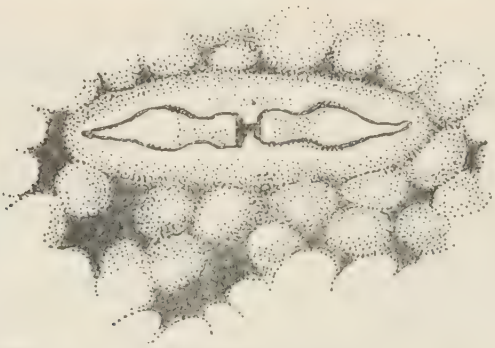

FIGURE 1.—OPHIDIASTER AGASSIZII. A CHARACTERISTIC PEDICELLARIA, X100

Dr. R. Koehler, in the citation noted above, has given a very full discussion of this species together with excellent figures.

PATIRIA CHILENSIS (Lütken)

Plate 3, Figures 1, 2

Asteriscus chilensis C. F. LÜTKEN, Vidensk. Med., 1859, p. 61.
Asterina chilensis C. F. LÜTKEN, Vidensk. Med., 1871, p. 302.—H. L. CLARK, Bull. Mus. Comp. Zoöl., vol. 52, 1910, p. 334, pl. 2, figs. 2, 3.
Patiria chilensis VERRILL, Amer. Journ. Sci., vol. 35, 1913, p. 482.

San Lorenzo, Island, Callao, Peru, November 1, 3, 1926, two specimens.

Antofagasta, Chile, November 15, 1926, one specimen.

The colors of the Peruvian specimens in life were recorded by Doctor Schmitt as: "Above, dark maroon purple with irregular lines and markings of nile blue; under side, glaucous green, tube feet cream buff" (Ridgway's, Nomenclature of Colors, 1886).

PATIRIELLA CALCARATA (Perrier)

Plate 4, Figures 1, 2

Asteriscus calcaratus PERRIER, Ann. Sci. Nat., ser. 5, vol. 12, 1869, p. 292.
Asterina calcarata, PERRIER, Rév. des Stellérides, 1875, p. 302.—H. L. CLARK, Bull. Mus. Comp. Zoöl., vol. 52, 1910, p. 333.—LIEBERKIND, Nat. Hist. Juan Fernandez and Easter Island, edited by Dr. Carl Skottsberg, vol. 3. Asteroidea, 1920, p. 383.

Asterina calcarata var. *selkirki* MEISSNER, Archiv f. Naturgesch., 1896, p. 97, pl. 6, fig. 3.
Patiriella calcarata VERRILL, Amer. Journ. Sci., vol. 35, 1913, p. 484.

Juan Fernandez, six specimens; one from 15 to 18 meters. Bahia de Padre, December 15, 1926.

Doctor Lieberkind, in the citation above, has given a critical review of this species.

PATIRIELLA FIMBRIATA (Perrier)

Plate 5, Figures 1, 2

Asterina fimbriata PERRIER, Rév. des Stellèrides. 1875. p. 307; Miss. sci. du Cap Horn, 1891, p. 111, pl. 12, figs. 5, 5*b*.—KOEHLER, Astéries et Ophiures, Further Zoological Results of the Swedish Antarctic Expedition 1901–1903, vol. 1, No. 1, 1923, p. 55, pl. 9, figs. 2, 5–8. Literature.
Patiriella fimbriata VERRILL, Amer. Journ. Sci., vol. 35, 1913, p. 484.

Punta Arenas, Magellan Strait, February 4, 1927, two specimens.

Port Stanley, Falkland Islands, March 11 and 27, 1927, five specimens (R, 5.5 to 8 mm.).

Near Teal Inlet, April 3, 1927, two specimens (R, 8 to 11 mm.).

Koehler (1923) has given critical notes and excellent figures of this species. His largest specimen had R 16 mm. In alcoholic specimens the delicate abactinal spinelets are more or less obscured by a soft skin, traversed by fine channels. It is relatively thicker in the smaller than in the largest specimens and disappears on drying.

PORANIA ANTARCTICA Smith

Porania antarctica SMITH, Ann. and Mag. Nat. Hist., ser. 4, vol. 17, 1876, p. 108.—SLADEN, *Challenger* Asteroidea, 1889, p. 360, pl. 59, fig. 3.—KOEHLER, Deuxième Exp. Ant. Française, Échinodèrmes, 1912, p. 66.—LUDWIG, Exped. Ant. Belge, Seesterne, 1903, p. 22, pl. 2, figs. 18–20.
Porania magellanica STUDER, Monatsber. preuss. Akad. Wiss. Berlin, July 1876, p. 459.—SLADEN, *Challenger* Asteroidea, 1889, p. 363, pl. 59, fig. 5.
Glabraster magellanica A. H. CLARK, Journ. Wash. Acad. Sci., vol. 6, 1916, p. 122.
Glabraster antarctica A. H. CLARK, Journ. Wash. Acad. Sci., vol. 6, 1916, p. 122.

Punta Arenas, Chile, February 1, 1927, one specimen.

For a critical discussion see Koehler, 1912, above. Sladen gives excellent figures of the entire animal, and Ludwig, details of skeleton.

HELIASTER HELIANTHUS (Lamarck)

Asterias helianthus LAMARCK, Animaux sans vertèbres, 1816, vol. 3, p. 245.
Heliaster helianthus DUJARDIN and HUPÉ, 1862, p. 343.—H. L. CLARK, Bull. Mus. Comp. Zoöl., vol. 51, 1907, p. 42, pl. 3, fig. 1; pl. 7, figs. 1–7.

Tocopilla, Chile, November 14, 1926, one specimen.

Salaverry, Peru, October 18, 1926, three specimens.

Clark gives a full description and figures. These specimens were taken well within the known range.

HELIASTER CANOPUS Perrier

Heliaster canopus PERRIER, Rév. des Stellérides, 1875, p. 88.—H. L. CLARK, Bull. Mus. Comp. Zoöl., vol. 51, 1907, p. 45, pl. 3, fig. 2; pl. 8, fig. 7.

Juan Fernandez, December 8, 1926, eight specimens.

The largest example has R. 72 millimeters and 21 rays. Clark, who gives a full description and figures, records 60 millimeters as being the maximum among his 27 specimens.

HELIASTER POLYBRACHIUS Clark

Heliaster polybrachius H. L. CLARK, Bull. Mus. Comp. Zoöl., vol. 51, 1907, p. 54, pl. 2, fig. 2; pl. 7, fig. 12; pl. 8, fig. 8.

Talara, Peru, August 29, 1926, two specimens.

As Clark points out, this is the mainland form of *H. cumingii* (Galápagos Islands). Reference should be made to Clark's paper for description and figures.

ASTROSTOLE PLATEI (Meissner)

Text Figures 2, 2*a*

Asterias (*Coscinasterias*) *platei* MEISSNER, Archiv f. Naturgesch., 1896, p. 103, pl. 6, fig. 2.

Astrostole platei FISHER, Bull. U. S. Nat. Mus. 76, part 2, 1928, p. 130.

Seven rays, some incomplete; no label, but in container with four specimens of *Heliaster canopus;* hence from Juan Fernandez. Material in poor condition.

Meissner has given a good figure of this species which is a typical *Astrostole.* The type is eight-rayed. Inner furrow-spine tapered, shorter and slenderer than outer, which is slender with truncate tip, but not tapered. Three series of prominent ventro-lateral spines, longer than adambulacrals and with flattened, rounded or truncate tips, often shallowly gouge-shape. Inner of these three series are actinals, the other two inferomarginals. They form also oblique transverse combs, the base of outer spine carrying prominent bouquet of crossed pedicellariæ.

Superomarginal spines about the same length, usually on alternate plates; a very irregular series of acicular carinal spines between which and superomarginals are irregularly spaced similar dorsolaterals corresponding to about two series on either side—all with conspicuous wreaths of crossed pediceliariæ, about 0.4 millimeter in length (figs. 2, 2*a*). Straight pedicellariae slender-lanceolate, rare except on furrow face of adambulacrals. Superomarginals with conspicuous area of tiny hyaline bosses.

This species is very nearly related to *Astrostole paschae* (H. L. Clark) of Easter Island. The general appearance of the two forms, and the details of the crossed pedicellariae are closely similar. The crossed pedicellariae of *paschae*[1] average about 0.35 millimeter in length (profile view) while those of *platei* are around 0.4 millimeter. Some reach 0.45 millimeter. Only one specimen of each species has

FIGURE 2.—ASTROSTOLE PLATEI. ABACTINAL CROSSED PEDICELLARIA, 0.42 MILLIMETERS LONG, X100, 2*a*. A SINGLE JAW, X200

been examined; in fact, no specimens of *paschae* other than the type are known.

MEYENASTER GELATINOSUS (Meyen)

Asterias gelatinosa MEYEN, Reise um die Erde, vol. 1, 1834, p. 222.—CLARK, Bull. Mus. Comp. Zoöl., vol. 52, 1910, p. 337, pl. 6, fig. 2.

Meyenaster gelatinosus VERRILL, Amer. Journ. Sci., vol. 35, 1913, p. 485.—FISHER, Bull. U. S. Nat. Mus. 76, part 2, 1928, p. 131, pl. 42, figs. 9, 9*a*; pl. 43, fig. 7.

Antofagasta, Chile, November 15, 1926, one specimen.

For a discussion of this genus see Fisher, citation above.

COSMASTERIAS LURIDA (Philippi)

Asteracanthion luridum PHILIPPI, Archiv f. Naturgesch., vol. 24, 1858, p. 265.

Cosmasterias lurida LUDWIG, Exped. Antarct. Belge, 1903, p. 40.—KOEHLER, Deux. Exp. Antarct. Française, Échinodèrmes, 1912, p. 23, pl. 2, figs. 1–7; pl. 5, fig. 8.

Punta Arenas, Strait of Magellan, February 5, 1927, one specimen (R., 29 mm.).

This species, of many aliases, is characteristic of the region of the Strait of Magellan and adjacent coasts of both Atlantic and Pacific sides; Tierra de Fuego; South Georgia; low tide to 348 fathoms.

[1] For figures see Fisher, Bull. U. S. Nat. Mus. 76, part 2, plate 42, figures 7, 7*a*.

Genus ANASTERIAS Perrier

Anasterias Perrier, Rév. Stell., 1875, p. 81; 1891, p. 91. Type *Anasterias minuta* Perrier.—Fisher, Smithsonian Misc Coll, vol. 52, 1908, p 52; Zool. Anz., vol. 33, 1908, p. 356; Ann. Mag. Nat. Hist., ser. 9, vol. 10, 1922, p. 592; vol. 18, 1926, p. 197; Bull. U. S. Nat. Mus. 76, part 3, 1930, p. 221.

Asteroderma Perrier, Comptes-rend., vol. 106, No. 11, 1888, p. 763; Mission sci. Cap Horn, 1891, p. 96. Type, *Asteroderma papillosum* Perrier.

[Not *Anasterias* Ludwig, 1903; nor Koehler, 1906, 1908, 1912, 1920, 1923; nor Verrill, 1914. See *Lysasterias*.]

Diagnosis.—Resembling *Sporasterias*, but the abactinal skeleton typically reduced to an open, delicate irregular mesh, entirely hidden by thick pulpy skin, which in the adult, even when dried, may conceal the underlying plates. Both series of marginal plates well developed; the superomarginals commonly monacanthid (or spineless), the inferomarginals diplacanthid; one series of actinals, sporadically spiniferous; adoral carina composed of about three pairs of contiguous postoral adambulacral plates; interbrachial septum strongly calcified; gonads opening ventrally—paedophoric.

Remarks.—The above diagnosis is intended to characterize two known species of a larger group which includes *Sporasterias* and possibly *Kalyptasterias*, and which by right of priority would be called *Anasterias*. This diagnosis of *Anasterias* is therefore of the subgenus *Anasterias*.

Notes on the history of this group will be found in Asteroidea of the North Pacific and Adjacent Waters, Part 3.[2] As there noted, the group is given generic rank in order to direct attention to the peculiar characters of *Anasterias*, ss. There seems to be no clear line of demarcation between *Anasterias* and *Sporasterias*.

ANASTERIAS MINUTA Perrier

Plate 6; Plate 7, Figures 1, 2; Plate 8

Anasterias minuta Perrier, Rév. Stell., 1875, p. 81; Mission sci. Cap Horn, 1891, p. 93 (part).—Fisher, Bull. U. S. Nat. Mus. 76, part 3, 1930, p. 223.

? *Asteroderma papillosum* Perrier, Comptes-rend, vol. 106, No. 11, 1888, p. 765; Mission sci. Cap Horn, 1891, p. 96.

? *Anasterias minuta* var *Asteroderma papillosum* Perrier, 1891, pl. 10, fig. 3*a*–3*c*.

The type of this species is in the Muséum d'Histoire Naturelle (E, 792, Hombron et Jacquinot, 1847, alcohol). Perrier considered the type locality to be Port Famine, Magellan Strait.

In addition to Doctor Schmitt's material, I have two dried specimens from Darwin Harbor, Choiseul Sound, Falkland Islands (No. 2623 Mus. Comp. Zoöl.). The smaller measures R, 18 millimeters, r, 6 millimeters: the larger R, 48 millimeters, r, 13 millimeters. In

[2] Bull. U. S. Nat. Mus. 76, part 3, 1930, p. 221.

the smaller example the abactinal skeleton is clearly visible and consists of a weak, irregular reticulum resembling the condition in *A. pedicellaris* as figured by Koehler [3] and closely similar to that of the type specimen of *minuta*. Most of the superomarginals carry one spinelet and the inferomarginals two, while scattered along the intermarginal channel and inside the furrow margin are rather numerous, lanceolate, straight pedicellariae two-thirds the length of the superomarginal spinelets. In the larger specimen, however, the abactinal integument has thickened and conceals the skeleton, which is quite weak and irregular as in Koehler's Plate 5, Figure 1, alluded to above. The proportions are about as in Figure 4. There are a few actinal plates and spines at the base of the ray and the adoral carina is composed of three pairs of contiguous adambulacrals, the first pair larger than second, and the second larger than third. The superomarginal spines have been mostly absorbed: pedicellariae as in the small example. A third specimen (No. 2624) carries a cluster of young.

Sixteen specimens from Port Stanley, Falkland Islands, collected February to April, 1927, by Dr. Waldo L. Schmitt (pls. 6, 7). These are evidently conspecific with the Darwin Harbor examples. A well-hardened alcoholic example (R., 48 mm.) resembles the *Kalyptasterias conferta* figured by Koehler.[4] The abactinal plates are slender, delicate, and form an irregular reticulum, with very large meshes, and are entirely hidden until dried by the soft pulpy integument. Dorsal spinelets few and widely scattered; only a few abactinal crossed and straight pedicellariae. Superomarginal plates normal, not massive, each with one blunt, terete, slender spinelet, 1 to 1.5 millimeters long; inferomarginals with two decidedly stouter and longer spines; actinal plates with one spine, slightly smaller, the series extending two-thirds length of ray, each spine forming with the inferomarginal spines a transverse series of three. Numerous, rather thickly lanceolate, subobtuse straight pedicellariae, decidedly longer than broad, are scattered on the marginal and actinal plates in the intermarginal channel and along edge of furrow. *No associated cross pedicellariae*, except near the end of the ray, and there only a few. [In *Sporasterias antarctica* the superomarginals are normally surrounded by crossed pedicellariae, and the inferomarginal plates carry at least a few on the intermarginal side of the spines.]

Another lot of nine from Port Stanley (April 16, 1927) differs in having numerous small capitate abactinal spinelets and fairly numerous abactinal (but not marginal) crossed pedicellariae; straight pedicellariae scattered over abactinal surface and distributed later-

[3] Swed. Antarctic Exp., vol. 1, no. 1, 1923, pl. 5, figs. 1 and 4.
[4] Idem, pl. 4, figs. 3 and 4.

ally and actinally without associated crossed pedicellariae; integument thick, pulpy, in alcohol. When dried a specimen would pass for an aberrant *Sporasterias antarctica*, with weak dorsal skeleton. One specimen carries a thick mass of eggs in the oral concavity.

There is a lot of 13 specimens from near Teal Inlet, Falkland Islands, ranging in size from R, 10 to R, 33 millimeters. Four of these (R, 27 to 33 mm.) have a rather thinner skin and numerous abactinal spinelets (pl. 8). When dried the abactinal skeleton is seen to be much stouter than in *minuta*. The specimens resemble *Sporasterias antarctica*, almost devoid of crossed pedicellariae and with practically no straight pedicellariae except on furrow margin. The other eight, probably collected at the same station, have the thicker integument and weak abactinal skeleton of *minuta*, but likewise have very few pedicellariae.

I do not know whether these two lots represent varieties of one species or two distinct species. They make any sharp separation of *Sporasterias* from *Anasterias* well-nigh impossible.

ANASTERIAS PEDICELLARIS (Koehler)

Sporasterias pedicellaris KOEHLER, Swed. Ant. Exp., vol. 1, No. 1, 1923, p. 18. pl. 5, figs. 1–6; pl. 6, figs. 1–5, 7–10.

Sporasterias antarctica KOEHLER, 1920, p. 78, pl. 18, fig. 4.

? Anasterias perrieri PERRIER, Mission sci. Cap Horn, 1891, p. 7 (*not* Studer, 1885). I have seen a specimen at the Muséum d'Histoire Naturelle.

Anasterias pedicellaris FISHER, Bull. U. S. Nat. Mus. 76, part 3, 1930, p. 225.

This species is fully described and figured by Koehler. He notes that in some specimens the spines and characteristic pedicellariae may be very slightly developed, or are even lacking. He writes also that the external appearance, in respect to the more or less soft consistency of the abactinal wall, resembles that of *Lysasterias*.

Under this nominal species I have tentatively classified several specimens, mostly in a bad state of preservation, which were collected at Port Stanley, Falkland Islands. The abactinal spinelets are fairly numerous, and scattered among them are numerous crossed pedicellariae. In contrast to the condition in *minuta*, a few crossed pedicellariae here and there accompany the conspicuous lanceolate pedicellariae of the superomarginal and inferomarginal plates (R, 40 mm., r, 12 mm.).

Koehler's material was taken at Tierra del Fuego, 36 meters, and the Falkland Islands, 7 to 10 meters. Certain specimens collected at low tide, Sparrow Cove, East Falkland, are probably the same as my *minuta*, since "les piquants et les pedicellaires sont très peu développés et ils font même complètement défaut sur certains exemplaires."

It is likely that *pedicellaris* and *minuta* are two "manifestations" of a single species.

ANASTERIAS CONFERTA (Koehler)

Kalyptasterias conferta KOEHLER, Further Zoological Results of the Swedish Antarctic Expedition 1901–1903, vol. 1, No. 1, 1923, p. 43, pl. 4, figs. 1–7.—FISHER, Bull. U. S. Nat. Mus. 76, part 3, 1930, p. 234.

Teal Inlet, Falkland Islands, April 11, 1927, one specimen (R, 33 mm.).

The abactinal plates have degenerated so that they are entirely disconnected. The skeleton is represented by scattered small circular and slender elongate ossicles. Similarly the marginal plates are reduced in size, the spineless superomarginals forming a slender sinuous longiseries, as called for by *Kalyptasterias*.

I think it likely that this specimen will eventually prove to be an extreme variant or forma of *A. minuta*. In view of the wide range of variation in *Anasterias* it will be very difficult to maintain *Kalyptasterias* even as a subgenus, as I suggested doing in a summary of southern Asteriinae.[5]

SPORASTERIAS ANTARCTICA (Lütken)

Asteracanthion antarcticum LÜTKEN, Vidensk. Med., 1856, p. 105.

Sporasterias antarctica LÜDWIG, Exp. Antarct. Belge, 1903, p. 39.—KOEHLER, Austral. Antarctic Exp., Series C, vol. 8, pt. 1, Asteroidea, p. 78, pl. 18, figs. 1–4; pl. 28, figs. 1–4.—FISHER, Bull. U. S. Nat. Mus. 76, part 3, 1930, p. 240.

Punta Arenas, Strait of Magellan, February 2, 3, 4, 1927, 46 specimens. Deseado, Patagonia, tide flats, May 7, 1927, 3 specimens. York Bay, Port William, Falkland Islands, March 20, 1927, 2 specimens.

STICHASTER STRIATUS (Müller and Troschel)

Asterias aurantiaca MEYEN, Reise um die Erde, vol. 1, 1834, p. 222 (not Linnaeus).

Stichaster striatus MÜLLER and TROSCHEL, Archiv f. Naturgesch., 1840, p. 321.—VERRILL, Shallow-water Starfishes, 1914, p. 362.—FISHER, Bull. U. S. Nat. Mus. 76, part 3, 1930, p. 241.

Stichaster aurantiacus VERRILL, Trans. Conn. Acad., vol. 1, part 2, 1867, p. 293.—CLARK, Bull. Mus. Comp. Zoöl., vol. 52, 1910, p. 337, pl. 8, fig. 1.

San Lorenzo Island, Callao, Peru, November 1, 3, 1926, two specimens.

Tocopilla, Chile, November 14, 1926, one specimen.

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[5] Bull. U. S. Nat. Mus. 76, part 3, 1930, p. 223.

EXPLANATION OF PLATES

PLATE 1

Ophidiaster agassizii, Juan Fernandez; abactinal surface, ×3.5.

PLATE 2

Ophidiaster agassizii; actinal surface of specimen figured in plate 1, ×4.

PLATE 3

FIGURE 1. *Patiria chilensis;* abactinal surface, ×2.
2. Same specimen; actinal surface, ×2.

PLATE 4

FIGURE 1. *Patiriella calcarata*, Juan Fernandez; abactinal surface, ×2.8.
2. Same specimen; actinal surface, ×2.8.

PLATE 5

FIGURE 1. *Patiriella fimbriata*, Port Stanley, Falkland Islands; abactinal surface, ×4.
2. Same specimen; actinal surface, ×4.

PLATE 6

Anasterias minuta, Port Stanley, Falkland Islands; abactinal aspect of a dried specimen of typical form, ×2.

PLATE 7

FIGURE 1. *Anasterias minuta;* actinal surface of specimen shown in plate 6, slightly less than twice natural size.
2. *Anasterias minuta;* young specimen from Port Stanley, ×3.5.

PLATE 8

Anasterias from near Teal Inlet, Falkland Islands, mentioned in text, p. 8; ×2.3.

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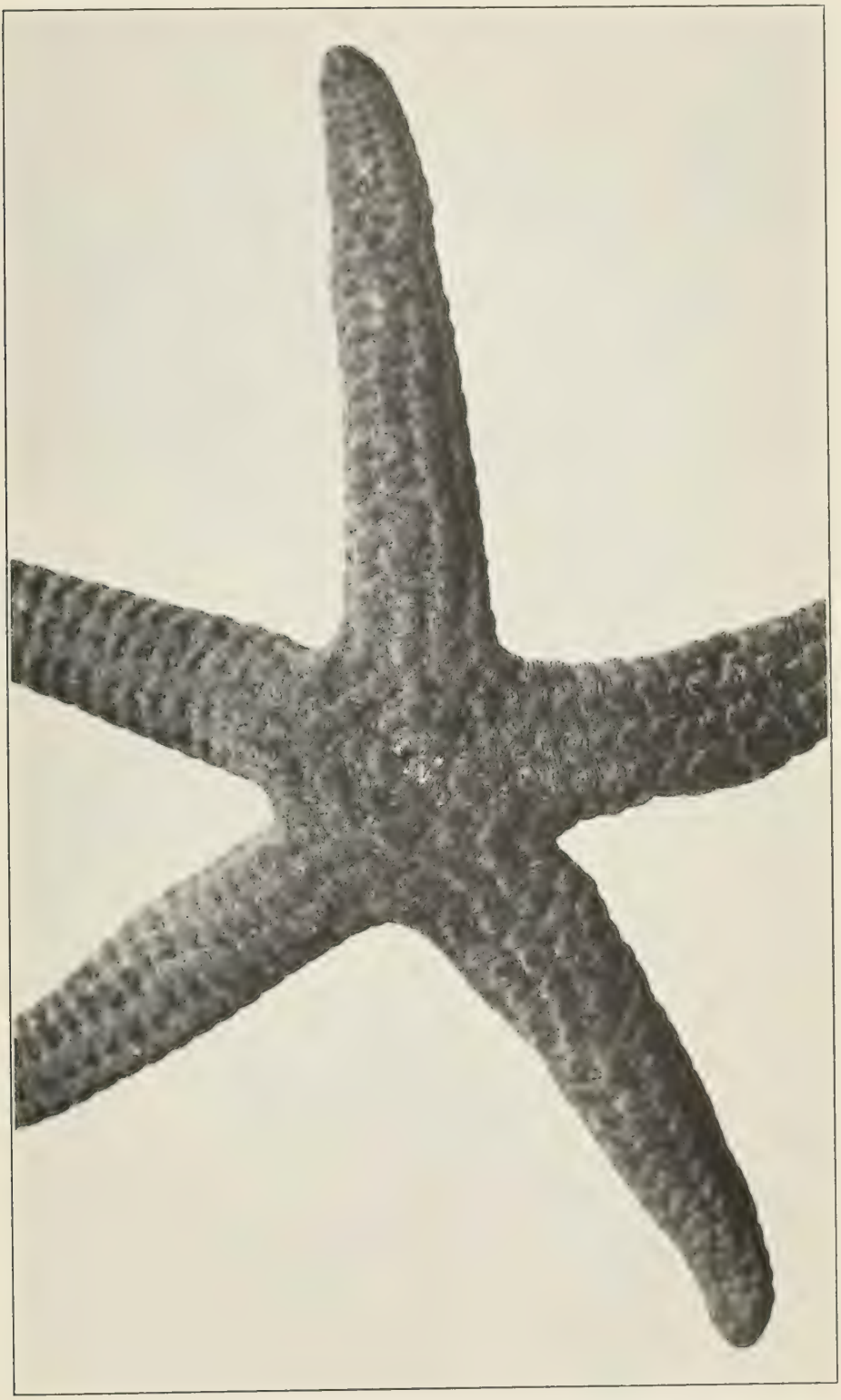
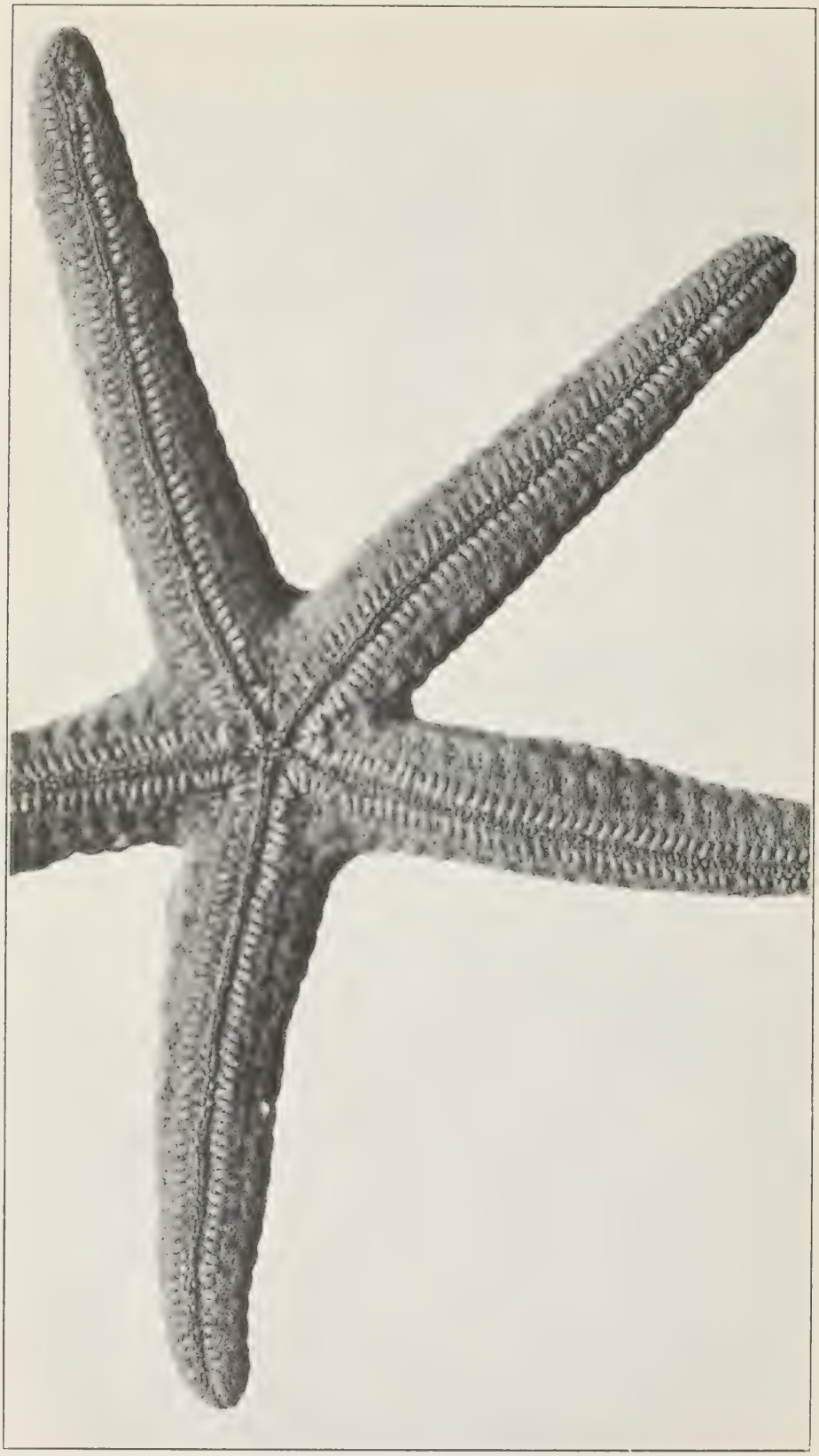


OPHIDIASTER AGASSIZII

FOR EXPLANATION OF PLATE SEE PAGE 10.



OPHIDIASTER AGASSIZII

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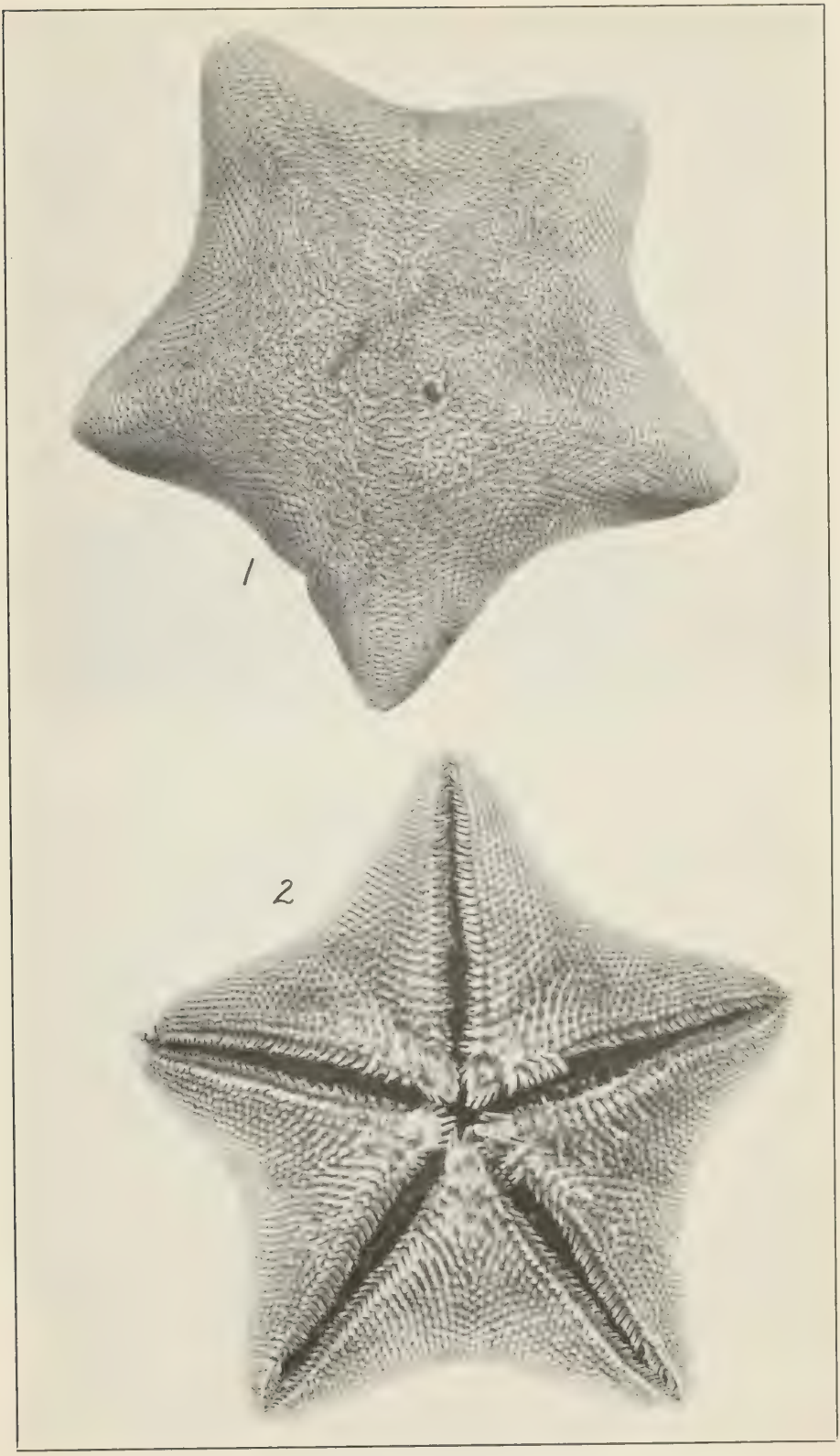

PATIRIA CHILENSIS

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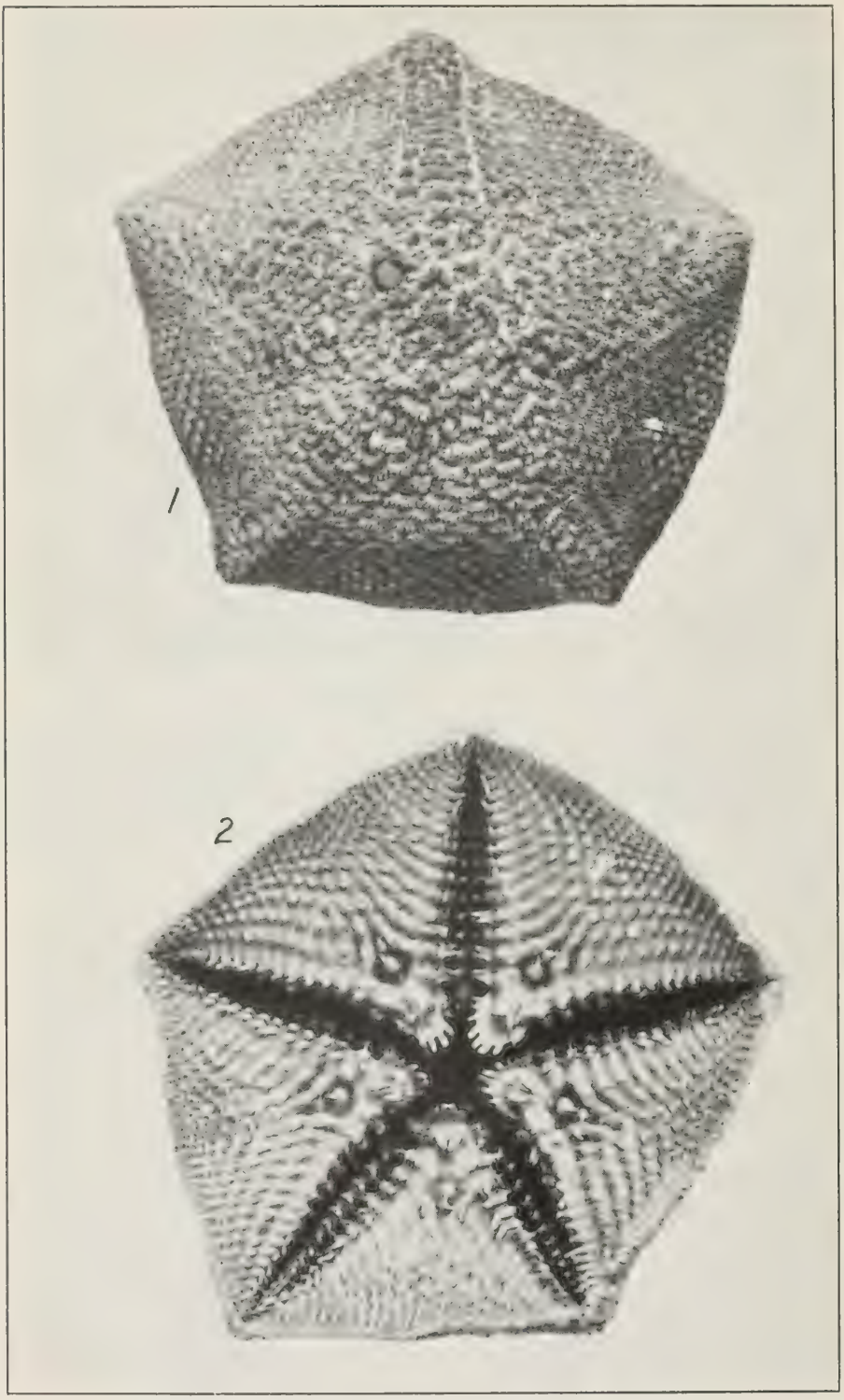

PATIRIELLA CALCARATA

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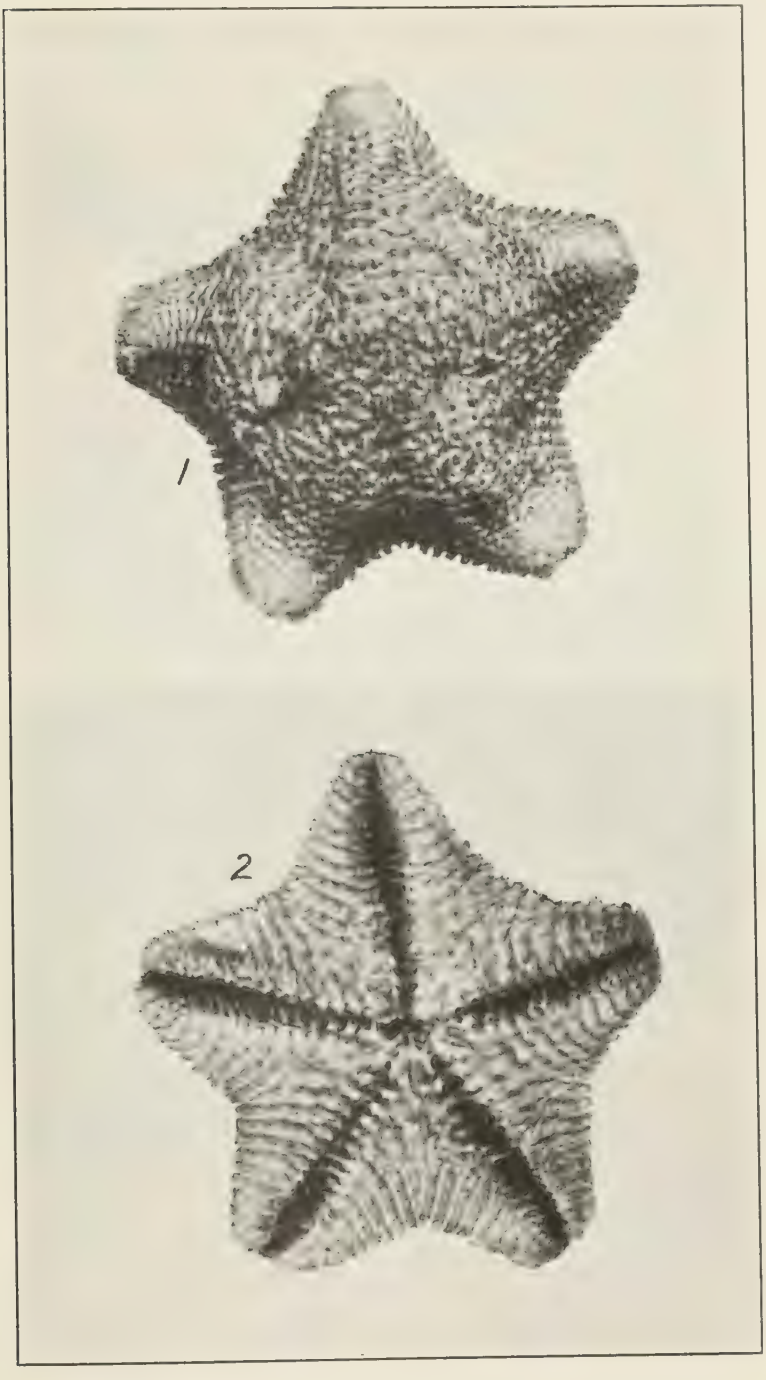

PATIRIELLA FIMBRIATA

FOR EXPLANATION OF PLATE SEE PAGE 10.

ANASTERIAS MINUTA

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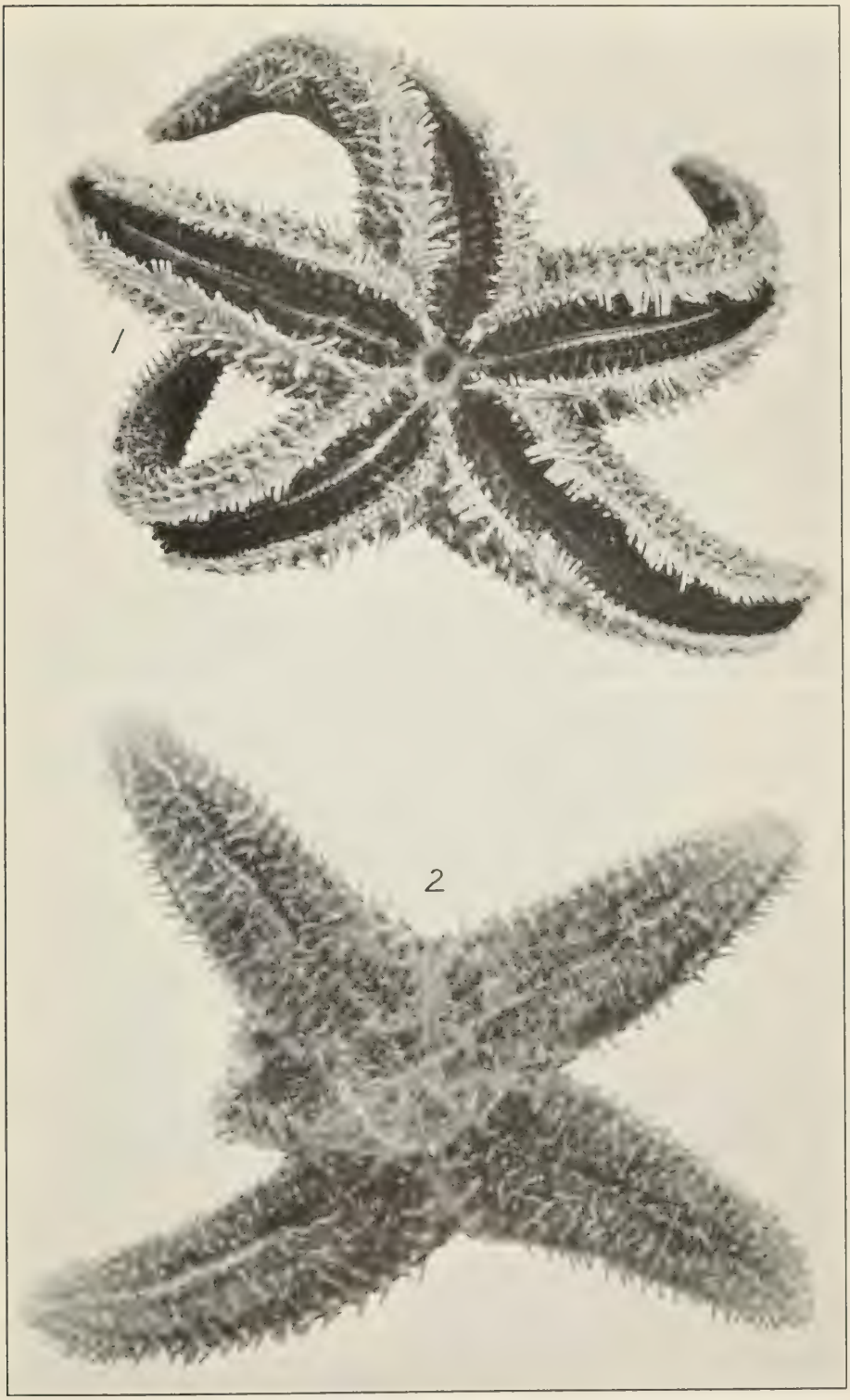

ANASTERIAS MINUTA

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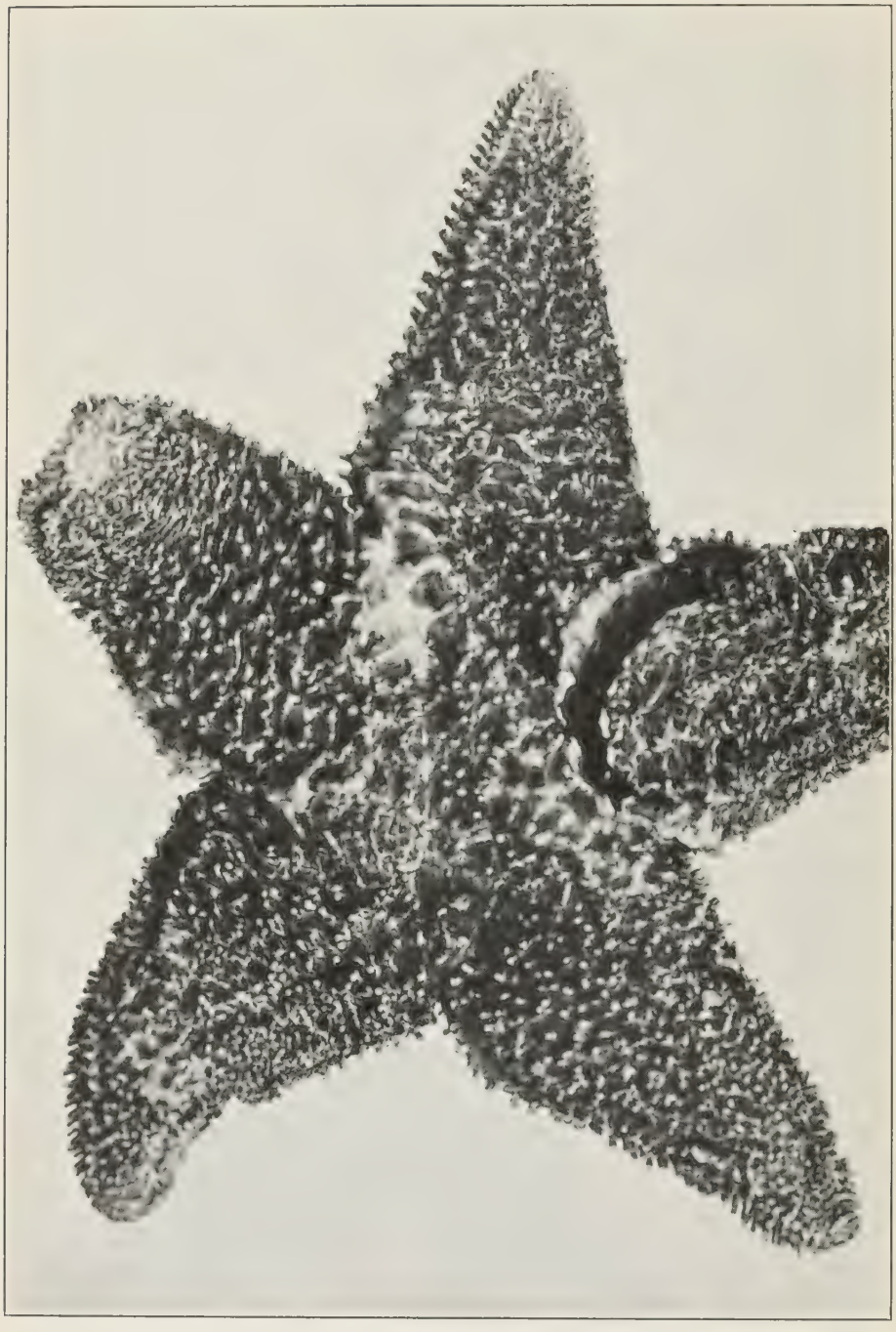

ANASTERIAS

FOR EXPLANATION OF PLATE SEE PAGE 10.

MOLLUSKS FROM THE ASPEN SHALE (CRETACEOUS) OF SOUTHWESTERN WYOMING

By John B. Reeside, jr.,

Of the U. S. Geological Survey, Washington, D. C.

and

A. Allen Weymouth,

Of the California Company, Denver, Colo.

INTRODUCTION

The Aspen shale of southwestern Wyoming has yielded few fossils except the abundant fish remains noted by everyone who has dealt with the formation, consequently a collection containing ammonites and a variety of pelecypods is worthy of special record in spite of the fact that their state of preservation leaves much to be desired. This material was secured by Mr. Weymouth during the course of field work for the California Co., and is derived from two localities on the Meridian anticline southeast of Kemmerer, Wyo. Interesting features of the collection are that it contains the genus *Acompsoceras*, not previously described from North America; the genus *Epengonoceras*, not previously described from the interior province, though its presence at a distant locality has been noted;[1] and a third genus, here named *Kanabiceras*, whose geographic range is much extended over that shown by previous records.

The photographs of specimens shown in the accompanying plates were made by W. O. Hazard and the photographs were retouched and the plates assembled by Miss Frances Wieser.

THE ASPEN SHALE

The Aspen shale of southwestern Wyoming was named in 1907 by Veatch,[2] the typical locality being the exposures near old Aspen

[1] Stanton, T. W., unpublished data.

[2] Veatch, A. C., Geography and geology of a portion of southwestern Wyoming: U. S. Geol. Survey Prof. Paper 56, p. 64, 1907.

station in T. 14 N., R. 118 W., Uinta County, on a part of the Union Pacific Railroad, since abandoned in favor of a shorter route lying some miles farther north. Veatch described the formation as "dark-colored, splintery, somewhat arenaceous shales containing abundant fish scales," and ascribed to it a thickness of 1,600 to 2,200 feet, with the average at 1,800 feet.

The beds comprised in the Aspen formation at the type locality had been clearly noted, however, by most of the earlier students of the region,[3] the references extending at least as far back as 1870. Stanton[4] in 1892 recorded near old Bear River City from "several hundred feet of bluish and brownish shales," that are undoubtedly part of the present Aspen shale, "teleost fish scales and crushed specimens of a *Prionocyclus* (perhaps *P. woolgari*)." These ammonites are now recognized as belonging to some species of *Metoicoceras*[5] and agree therefore with the fauna described below. Schultz has in several papers[6] described the Aspen shale of the same general region. He records it as composed of black shale, dark drab arenaceous shale and gray sandstone, 1,200 to 1,800 feet thick but averaging 1,600 feet, at places weathering into small splintery fragments and producing long rounded hills of peculiar silver-gray color, and containing abundant fish scales. In sec. 19, T. 24 N., R. 115 W., Lincoln County, it yielded specimens of *Lingula* species.

The most notable lithologic feature of the Aspen shale is the presence of zones of a very hard, very fine-grained rock which weathers to a platy, very light gray, resistant material and causes the formation of conspicuous and very characteristic ridges along the outcrop. Identical material constitutes most of the Mowry shale of central and eastern Wyoming, recently studied by W. W. Rubey,[7] who concluded that its peculiarities are due to an unusual content of silica, and that this was derived from the alteration of volcanic ash. The fossils described in the present paper are all preserved in this hard siliceous rock. Mr. Rubey has studied specimens of this matrix and has very kindly contributed the following note:

The three samples from the Aspen formation are all very hard, light to medium gray, fine-grained rocks. The sample reported as most representative is somewhat coarser grained than the others and distinctly light gray, both on the weathered surface and in fresh fracture. Its weathered surface is con-

[3] For references see Veatch, footnote 2.

[4] Stanton, T. W., The stratigraphic position of the Bear River formation: Amer. Journ. Sci., ser. 3, vol. 43, p. 104, 1892.

[5] Stanton, T. W., personal communication.

[6] Schultz, A. R., Coal fields in a portion of central Uinta County, Wyo.: U. S. Geol. Survey Bull. 316, p. 215, 1907; Geology and geography of a portion of Lincoln County, Wyo.: U. S. Geol. Survey Bull. 543, pp. 30, 59, 1914; A geologic reconnaissance for phosphate and coal in southeastern Idaho and western Wyoming: U. S. Geol. Survey Bull. 680, pp. 13, 28, 1918.

[7] Rubey, W. W., Origin of the siliceous Mowry shale of the Black Hills region: U. S. Geol. Survey Prof. Paper 154, pp. 153–170, 1929.

spicuously marked by abundant white spots from ⅓ to 1 or 2 millimeters in diameter. The other two samples are nearly alike—both are very light gray on the weathered surface and medium gray on fresh fracture.

Microscopic examination shows that the white-spotted sample is a rhyolitic tuff that consists of volcanic glass, angular quartz grains, and calcite. The glass, which constitutes about 75 per cent of the rock, is very pale brownish gray and minutely porous. Its refractive index is slightly less than 1.50 and corresponds to that of a highly silicic glass. Numerous and well-preserved curving plates and cuspate shards of this glass show clearly the vitroclastic texture of the rock. A very small amount of cryptocrystalline material in the glass indicates that it has been slightly devitrified. The white spots so noticeable in the hand specimen are the larger masses of this porous glass. The crystalline grains, about 10 per cent of the rock, are exceedingly angular fragments and very thin flakes from less than 0.01 to 0.18 (commonly about 0.06) millimeter in diameter. Quartz predominates but mixed with it is some sanidine or orthoclase and a few crystals or fragments of zircon, magnetite(?), biotite, plagioclase, and hornblende(?). The rock is distinctly laminated with layers about 0.2 millimeter thick of these crystalline grains alternating with thick and thin layers of the glass. These crystalline grains afford no evidence that they are clastic sand grains, and, although possibly entirely clastic, it seems more probable that they are largely fragments of phenocrysts crystallized before the explosions or of shattered wall rock blown from the sides of the volcanoes. The calcite, about 15 per cent of the rock, occurs as large anhedral crystals concentrated chiefly near the quartz grains, but also distributed here and there throughout the glass. No clay minerals were recognized in this sample.

The two darker gray samples might be termed argillaceous tuffs or tuffaceous mudstones. Both contain volcanic glass and angular quartz grains, but they also contain clay and organic matter and a considerable amount of cryptocrystalline material (in part at least devitrified glass). In neither of them was any calcite recognized. The sample from 80 feet below the top of the formation contains more clay and organic matter and less glass than the one from 300 feet below the top. However, in both there is approximately 50 per cent or more of glass, the vitroclastic texture of which is still preserved. The angular quartz grains in both specimens range from less than 0.01 to 0.08 (commonly about 0.02) millimeter in diameter. These samples are not distinctly laminated, but the small lenses of organic matter and the clay crystals all have a parallel orientation.

In general appearance in the hand specimen, these two dark gray samples from the Aspen formation greatly resemble the Mowry shale of northeastern Wyoming, and in thin section there is a striking similarity in the constituents, in the size of grain, and especially in the presence of more or less altered rhyolitic ash in both formations. But the relative proportions of these constituents are very different—even the more clayey and organic sample of the Aspen contains far less clay and organic matter and much more fresh volcanic glass than samples of the Mowry. Furthermore, the angular quartz grains, though of approximately the same size in both formations, are distinctly more numerous in the Aspen. That is, the two formations appear to be made up of the same constituents, but the Mowry shale contains much less volcanic débris or else the volcanic glass originally in it is now much more thoroughly devitrified.

Under the Aspen shale lies conformably the thick Bear River formation of dark shales containing thin beds of sandstone and

limestone and beds of carbonaceous material, and yielding a large fauna of chiefly nonmarine species, together with a few marine forms that indicate Upper Cretaceous age.[8] Above the Aspen shale lies conformably the Frontier formation,[9] a group of sandstones inclosing shales and beds of coal, the whole several thousand feet thick. Parts of the formation have yielded a marine fauna which includes the following species as identified by T. W. Stanton: *Barbatia* species, *Inoceramus labiatus* Schlotheim, *I.* aff. *I. erectus* Meek, *Pteria* species, *Ostrea soleniscus* Meek, *O. sannionis* White, *Lima* species, *Anomia* species, *Anatina* species, *Modiola* species, *Pholadomya* species, *Cardium curtum* Meek and Hayden, *C. paupereulum* Meek?, *Tellina modesta* Meek, *T.* (*?*) *isonema* Meek, *Donax cuneata* Stanton, *Mactra emmonsi* Meek, *Corbula mematophora* Meek, *Gyrodes* species, *Turritella* species, *Glauconia coalvillensis* Meek, *Pugnellus fusiformis* (Meek), *Fusus utahensis* Meek?, *Admetopsis subfusiformis* Meek.

THE ASPEN FAUNA AND ITS RELATIONS

As noted previously there have been reported from the Aspen formation to date only scales and other remains of fishes, *Metoicoceras* species and *Lingula* species. To these the present paper adds:

Pteria (*Oxytoma*) species.
Ostrea species.
Anomia species.
Periplomya? aspenana Reeside and Weymouth, new species.
Thracia? wyomingensis Reeside and Weymouth, new species.
Tancredia? lincolniana Reeside and Weymouth, new species.
Aphrodina? aspenana Reeside and Weymouth, new species.
Linearia? species.
Tellina? species.
Mactra? incompta (White)?
Mactra? aspenana Reeside and Weymouth, new species.
Kanabiceras wyomingense Reeside and Weymouth, new genus and species.
Epengonoceras aspenanum Reeside and Weymouth, new species.
Metoicoceras whitei Hyatt.
Metoicoceras species.
Acompsoceras americanum Reeside and Weymouth, new species.

[8] White, C. A., The Bear River formation and its characteristic fauna: U. S. Geol. Survey Bull. 128, 1895. A. C. Veatch, U. S. Geol. Survey, Prof Paper 56, pp. 60–64.
[9] Veatch, A. C., U. S. Geol. Survey, Prof. Paper 56, pp. 65–69.

Besides the mollusks in the matrix of the specimens described in this paper the fish scales *Leucichthyops vagans* Cockerell [10] and *Erythrinolepis mowriensis* Cockerell [11] were noted.

All of these species except some of the specimens of *Metoicoceras whitei* came from the NW. ¼ sec. 32, T. 21 N., R. 115 W., at horizons 70 to 100 feet below the top of the formation, which is there 670 feet thick. Some of the specimens of *Metoicoceras whitei* Hyatt came from sec. 17, T. 16 N., R. 117 W., at a horizon 350 feet below the top of the formation, which is there 820 feet thick.

The pelecypods help but little in the correlation of the fauna. The ammonites, on the contrary, assist materially. *Kanabiceras* occurs in the middle Eagle Ford shale of Texas, in the Greenhorn limestone of eastern Colorado, in the lower part of the Colorado group in southern Utah, and in the Mowry shale of southern Wyoming, in all these in association with species of lower Turonian age, such as *Inoceramus labiatus*. *Epengonoceras* occurs in the middle part of the Eagle Ford shale of Texas and in the Mowry shale of the Black Hills of eastern Wyoming, in both regions in association with lower Turonian species; and in somewhat older beds elsewhere, as the upper Cenomanian of France. *Metoicoceras* is widespread in America, chiefly in beds of lower Turonian age—middle Eagle Ford shale, Greenhorn limestone, lower part of the Mancos shale, Mowry shale, Mosby sandstone member of Warm Creek shale, etc.—though in Texas it occurs also in somewhat older beds (lower Eagle Ford or upper Woodbine),[12] and in Europe is said to range from upper Cenomanian to lower Turonian. The species found in the Aspen shale is Turonian. *Acompsoceras* has been reported from the Cenomanian of Europe and north Africa, but not yet from the Turonian. The writes consider the Aspen fauna to be of lower Turonian age and equivalent to that of the lithologically similar Mowry shale, though it has some similarity to that of the Greenhorn limestone, which in the Black Hills region lies as much as 1,000 feet above the Mowry shale. The relations of the Aspen shale to the lower part of the Colorado group at various other places can be determined in only a general way—that is, it is equivalent in age to a very early part.

[10] Cockerell, T. D. A., Some American Cretaceous fish scales, with notes on the classification and distribution of Cretaceous fishes: U. S. Geol. Survey, Prof. Paper 120, p. 180, pl. 34, fig. 13; pl. 35, figs. 1–15, 1919.

[11] U. S. Geol. Survey, Prof. Paper 120, p. 182, pl. 36, figs. 3–6.

[12] Stephenson, L. W., unpublished data.

DESCRIPTION OF SPECIES

Family PTERIIDAE Meek

Genus PTERIA Scopoli

Subgenus OXYTOMA Meek

PTERIA (OXYTOMA) species undetermined

Plate 1, Figure 5

A single small external mold of a species of *Pteria* (*Oxytoma*), preserved in the living chamber of *Acompsoceras americanum*, presents features that mark it as an unnamed form. In the absence of other material it is not possible to tell whether this single individual is juvenile or mature, and the writers have therefore left it unnamed.

The specimen represents a left valve with a width of 3 millimeters parallel to the hinge margin and a height of 2 millimeters. The posterior wing is proportionately large and the body of the shell stout and well rounded. The ribs, about 30 in number, are of even size and rather closely spaced on the anterior and posterior parts of the valve, but are more distant and alternate in height on the middle section. The posterior wing is ribbed, relatively large, and shallowly emarginate.

No comparable species has been recorded from beds in the Interior Province as old as the Aspen shale except a large undescribed individual from the Thermopolis shale of the Crow Indian Reservation in southern Montana. *Pteria* (*Oxytoma*) *nebrascana* (Evans and Shumard)[13] and *P.* (*O.?*) *haydeni* Hall and Meek[14] are both much larger and come from much higher horizons.

Cat. No. 73763, U.S.N.M.

Family OSTREIDAE Lamarck

Genus OSTREA Linnaeus

OSTREA species

Plate 2, Figure 3

Several of the specimens of *Epengonoceras aspenanum* were overgrown by a small oyster with subcircular valves, almost unsculptured and lacking in features which would serve to differentiate it from similar simple forms occurring at many horizons. It is recorded here for the sake of completeness. These specimens might be the

[13] Meek, F. B., Invertebrate Cretaceous and Tertiary fossils of the Upper Missouri country: U. S. Geol. Survey Terr. Rept., vol. 9, p. 34, pl. 16, fig. 3; pl. 28, fig. 11, 1876.
[14] Idem, p. 33, pl. 16, fig. 2.

young of *Ostrea prudentia* White, but it is not possible to be sure of their identity.

Family ANOMIIDAE Gray

Genus ANOMIA Linnaeus

ANOMIA species

Plate 1, Figures 2, 3

Two moulds of the exterior of valves represent a species of *Anomia* with but little sculpture.

Valve subcircular in outline, with cardinal margin nearly straight, however; umbones marginal or almost so, inconspicuous. Surface ornamented by concentric lines of growth and a few distant and rather faint radial lines. Internal characters entirely unknown.

Length of larger specimen, 19 millimeters; height, 18 millimeters.

Such forms as this are much alike at widely separated horizons, and in the absence of better material it seems of little value to apply a specific name or attempt comparisons.

Cat. No. 73764, U.S.N.M.

Family ANATINIDAE Dall

Genus PERIPLOMYA Conrad

PERIPLOMYA? ASPENANA, new species

Plate 1, Figure 1

A single natural cast of the exterior of a left valve is similar to *Periplomya applicata* Conrad.[15] As noted by Wade, some of the European forms assigned to *Thracia* are not very strikingly different from Conrad's species or the present one, and the status of the genus *Periplomya* and its species should not be considered settled until more is known about them. Though the material in hand is scant foundation for a new species the shell is sufficiently characterized to deserve a name.

Valve depressed, elongate-oval in outline and nearly symmetrical, with an oblique carination extending posteriorly from the beak. No fissure visible in the beak of the type, though shell is entirely absent. Sculpture is even over entire valve, consisting of rather distant concentric lines parallel to the margin. Internal characters entirely unknown. Length, 44 millimeters; height, 25 millimeters; depth of valve, as preserved, about 5 millimeters.

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[15] Wade, Bruce, The fauna of the Ripley formation on Coon Creek, Tenn.: U. S. Geol. Survey Prof. Paper 137, p. 75, pl. 24, fig. 3, 1926. Wade erroneously designates this species *Periploma*, but it is the genotype of *Periplomya* Conrad (Amer. Journ. Conchology, vol. 3, p. 15, 1867; vol. 6, p. 76, 1870).

No species recorded from the interior province is sufficiently close to *Periplomya? aspenana* to deserve comparison. *P. applicata*, from the later Upper Cretaceous of the Coastal Plain, tapers more posteriorly and has finer sculpture but is very similar in gross form.

Holotype.—Cat. No. 73765, U.S.N.M.

Family THRACIIDAE Dall

Genus THRACIA Leach

THRACIA? WYOMINGENSIS, new species

Plate 1, Figure 10

Two natural casts of the exterior of right valves have the form of some shells generally assigned to *Thracia*, except that as here preserved they are not as inflated. Few details are preserved, but the writers have ventured to apply a specific name in the belief that the species will be recognizable in future collections. The specimens are compressed, ovate in general outline, rostrate posteriorly; beak not prominent, subcentral, with a diagonal depression extending posteriorly from it. Anterior and basal margins evenly convex; posterior margin nearly straight, vertical; dorsal margin nearly straight anteriorly, emarginate posteriorly, angle at the beaks 90°. Only sculpture shown is distant concentric lines. Internal characters entirely unknown.

Length, 21 millimeters; height, 18 millimeters; depth, as preserved, 2 millimeters.

No described form in the American Cretaceous known to the writers is much like *Thracia? wyomingensis*.

Holotype.—Cat. No. 73766, U.S.N.M.

Family TANCREDIIDAE Fischer

Genus TANCREDIA Lycett

TANCREDIA? LINCOLNIANA, new species

Plate 1, Figure 6

A single mold of the exterior represents a left valve with the form of some species of the genus *Tancredia*. It is compressed; the dorsal margin nearly horizontal for a distance of about 6 millimeters behind the beak, very slightly emarginate in front of the beak, angle at the beak about 150°; ventral margin gently and evenly convex; the anterior margin tapered, the posterior rather sharply truncated in an oblique direction and apparently permitting a gape. Beak inconspicuous; two faint depressions, possibly accidental, diverging

at an angle of about 70° from the beak. Sculpture of fine concentric lines with a few low obscure folds parallel to them. Internal characters entirely unknown. Length, 23 millimeters; height, 14 millimeters; depth of valve, as preserved, about 2.5 millimeters.

No species in the American cretaceous deposits, known to the writers, seems near enough to *Tancredia? lincolniana* to require comparison.

Holotype.—Cat. No. 73767, U.S.N.M.

Family VENERIDAE Leach

Genus APHRODINA Conrad

APHRODINA? ASPENANA, new species

Plate 1, Figures 7, 8

A mold of the exterior of a right valve retaining the central part of the shell and therefore showing some internal characters and a second, incomplete mold of the exterior represent this species. The outline of the valve is round-oval with all the margins evenly convex; valve rather shallow for the genus; angle at the beak about 120°. Sculpture of unequal concentric lines. Pallial line shows deep but blunt sinus; muscle scars not prominent. Hinge and other characters unknown.

Length, 27 millimeters; height, 23 millimeters; depth as preserved, 5 millimeters.

Of the seemingly related forms of comparable age, "*Callista*" *orbiculata* (Hall and Meek)[16] is higher and stouter; "*Callista*" *tenuis* (Hall and Meek)[17] is smaller and stouter. The much later species "*Callista*" *deweyi* Meek and Hayden[18] has some resemblance, but the outline of the valve is less orbicular.

Holotype and paratype.—Cat. No. 73768, U.S.N.M.

Family TELLINIDAE Deshayes

Genus LINEARIA Conrad

LINEARIA? species

Plate 1, Figure 9

A single natural cast of the exterior of a valve suggests *Linearia* in its general appearance, but so few details are available that no further assignment is warranted. The specimen is depressed, sym-

[16] Meek, F. B., Invertebrate Cretaceous and Tertiary fossils of the upper Missouri country: U. S. Geol. Survey Terr. Rept., vol. 9, p. 186, pl. 5, fig. 2, 1876.

[17] Idem, pl. 5, fig. 1.

[18] Idem, p. 182, pl. 17, fig. 15.

metrically oval, transversely elongated, and shows traces of concentric lines. Other characters obliterated.

Length, 25 millimeters; height, 16 millimeters; depth of crest, 2.5 millimeters.

Various forms resemble this, but comparisons seem of little value. No species of similar age is known in the interior region, however.

Cat. No. 73769, U.S.N.M.

Genus TELLINA Linnaeus

TELLINA? species

Plate 1, Figure 4

A single specimen constituting a mold of the interior of a left valve and preserving a little of the shell seems to belong to the genus *Tellina* but preserves so few details as to make a definite assignment difficult.

Valve depressed, in general transversely elongate-oval, with a posterior basal angle, to which a faint ray extends from the low beak. Anterior dorsal margin shorter than posterior dorsal margin, both nearly straight; basal margin gently convex; anterior margin evenly rounded; posterior margin oblique, straight. Sculpture visible is of fine concentric lines. Other characters not shown.

Length, 19 millimeters; height, 12 millimeters; depth, 2 millimeters.

No form much like this and of comparable age has been described from the interior region.

Cat. No. 73770, U.S.N.M.

Family MACTRIDAE Gray

Genus MACTRA Linnaeus

MACTRA? INCOMPTA (White)?

Plate 1, Figures 12, 13

Three molds of the exterior of valves are very much like *Mactra? incompta* (White)[19] in size and form, differing only on the finer and less regular concentric sculpture. Though this difference may be due only to the manner of preservation it seems best to question the identification of the material in hand until better specimens are available.

The valves are ovate-subtrigonal in outline, moderately convex; beaks about one-third the length behind the anterior margin, only moderately prominent as preserved; angle at the beaks a trifle more

[19] White, C. A., The invertebrate fossils collected in portions of Nevada, Utah, Colorado, New Mexico, and Arizona: U. S. Geog. Surveys W. 100th Mer. Rept., vol. 4, pt. 1, p. 185, pl. 17, fig. 6, 1877.

than 90°; anterior margin broadly convex, basal margin very gently convex, posterior margin narrowly convex; posterior umbonal ridge poorly defined. Surface shows only fine concentric lines of unequal elevation. Internal characters entirely unknown.

Length, 18 millimeters; height, 16 millimeters; depth of valve, 4 millimeters.

The original *Mactra? incompta* came from a locality 5 miles above Pueblo, Colo., probably in the Carlile shale, though possibly older.

Plesiotypes.—Cat. No. 73771, U.S.N.M.

MACTRA? ASPENANA, new species

Plate 1, Figure 11

A single mold of the exterior of a valve represents a species similar in general expression to *Mactra? incompta* White? but differing enough in outline to deserve record as a different species. It is much longer proportionately and shallower though also a small species with a sculpture of fine unequal concentric lines. None of the species of similar age is near it, though it suggests the much younger *Mactra? canonensis* Meek.[20] Internal characters entirely unknown.

Length, 20 millimeters; height, 14 millimeters; depth of valve, 3 millimeters.

Holotype.—Cat. No. 73772, U.S.N.M.

Family ACANTHOCERATIDAE Douvillé

KANABICERAS, new genus

Stanton[21] in 1894 described from a lower Turonian horizon near the base of the local Cretaceous section at Upper Kanab, Utah, the ammonite *Acanthoceras? kanabense*. It was not figured again until 1927, when Moreman[22] published a figure of a specimen from the Turonian part of the Eagle Ford shale of north Texas that shows features not present in the type of the species. Adkins[23] has suggested that Moreman's species is not Stanton's species and that the latter may belong to *Protacanthoceras* Spath.[24] A comparison of the

[20] White, C. A., Contributions to invertebrate paleontology, No. 1: Cretaceous fossils of the Western States and Territories: U. S. Geol. Geog. Survey Terr., Eleventh Ann. Rept. (1877), p. 297, pl. 9, fig. 11, 1879.

[21] Stanton, T. W., The Colorado formation and its invertebrate fauna: U. S. Geol. Survey Bull. 106, p. 181, pl. 36, figs. 6–8, 1894.

[22] Moreman, W. L., Fossil zones of the Eagle Ford of north Texas: Journ. Paleontology, vol. 1, p. 95, pl. 13, fig. 5, 1927.

[23] Adkins, W. S., Handbook of Texas Cretaceous fossils: Texas Univ. Bull. 2838, p. 245, 1928.

[24] Spath, L. F., On the ammonite horizons of the Gault and contiguous deposits: Geol. Survey Great Britain Mem., Summary Progress for 1922, p. 144, 1923.

Sharpe, Daniel, Description of the fossil remains of Mollusca found in the chalk of England, Part I, Cephalopoda: Palæontographical Soc. Mon., p. 25, pl. 9, fig. 3, 1853.

two figured specimens has convinced the writers, however, that the forms are inseparable specifically and that they have little in common with *Protacanthoceras*. The associates of *A.? kanabense* in Utah include "*Helicoceras*" *pariense* Stanton, *Baculites gracilis* Shumard, *Metoicoceras whitei* Hyatt (as *Buchiceras swallowi* Hyatt), and *Placenticeras* sp.[25] The associates listed by Moreman in Texas include *M. whitei*, *M. whitei* var. (as *M. swallowi* Shumard), *Scaphites* aff. *warreni* M. and H. (as *S. vermiformis* Meek), *Placenticeras pseudoplacenta* Hyatt, *Romaniceras* species (as *Acanthoceras* species), *Baculites gracilis* Shumard, *Inoceramus fragilis* Hall and Meek (as *I. labiatus* Schlotheim).

In the material from the Aspen shale a single external mold of the flank of an ammonite shows features so similar to those of *Acanthoceras? kanabense* that the writers have little doubt of their being congeneric though specifically distinct. To receive these two species the writers propose the genus *Kanabiceras* with *A.? kanabense* Stanton as genotype. The following characters may be noted:

Shell fairly stout; whorls somewhat depressed. Sculpture irregular, coarse, consisting of three rows of small, uneven nodes on the venter, the median row at places forming a rough keel; a row of rather distant, long marginal spines which appear to be hollow at the base and on the internal moulds appear as rounded or truncated, heavy, blunt nodes; between the marginal nodes faint uneven ribs; a row of uneven umbilical nodes. The suture only moderately dissected, with first lateral saddle narrow, first lateral lobe wide, bifid; other elements small.

The described characters of *Acanthoceras eschi* Solger[26] from the Mungo chalk of Kamerun, Africa, suggest strongly that it also may belong to *Kanabiceras*, but the writers prefer at this time to make this assignment only tentative.

KANABICERAS WYOMINGENSE, new species

Plate 1, Figure 14

Shell evidently stout-whorled, with relatively small umbilicus—about one-fifth the diameter; umbilical shoulder rounded. Aperture unknown. The type specimen shows a single whorl. There are six or seven blunt irregular nodes near the umbilicus, increasing much in height from the earlier to the later part. There would be 16 marginal nodes, if the complete margin were present, also increasing in height from the earlier to the later part, somewhat irregular, in part

[25] Stanton, T. W., U. S. Geol. Survey Bull. 106, p. 35.

[26] Solger, Friedrich, Die Fossilien der Mungokreide in Kamerun und ihre geologische Bedeutung, in Esch, Ernst, and others: Beiträge zur Geologie von Kamerun, pt. 2, p. 124, pl. 4, figs. 1–4, text fig. 21, 1904.

truncated. Poorly defined and irregular ribs show between the tubercles. Ventral part of shell unknown. Suture unknown.

This species is characterized by its small umbilicus and strong umbilical tubercles and differs in these characters from *Kanabiceras kanabense*. A specimen in hand from the Mowry shale of central Wyoming is very much like *K. wyomingense* and may be identical, though it is not as well preserved. The writers know of no other species which could well be brought into comparison here.

Holotype.—Cat. No. 73773, U.S.N.M.

Family ENGONOCERATIDAE Hyatt

Eight specimens of an engonoceratid ammonite are contained in the collection. The family Engonoceratidae Hyatt has been variously interpreted but is probably best viewed as containing the genera *Protengonoceras* Hyatt, 1903, *Engonoceras* Neumayr and Uhlig, 1881, *Hypengonoceras* Spath, 1922, *Parengonoceras* Spath, 1924, *Metengonoceras* Hyatt, 1903, and *Epengonoceras* Spath, 1924. At one time or another there have also been included, probably because of the possession of relatively simple, rounded saddles, *Neolobites* Fischer, *Hoplitoides* Von Koenen, *Indoceras* Noetling, *Sphenodiscus* Meek, and *Flickia* Pervinquière, but they would seem better placed in other families.

As thus constituted the family may be characterized as follows:

Shell much compressed, discoid, narrowly umbilicate. Venter truncated, though very narrow in several genera, becoming rounded in old age. Flanks smooth or with broad low falcate folds. Septa gently curved, not deeply incised, containing in the adult many lobes and saddles; lobes only moderately serrated, saddles often rounded, entire; ventral lobes short, simple. spreading, usually with pointed short, entire siphonal saddle.

The constituent genera may be briefly characterized as follows:

Protengonoceras Hyatt,[27] genotype *P. gabbi* (Böhm). Albian-?Turonian. Shell smooth except in late stages where folds appear. Venter concave, bordered by sharp, smooth ridges. Saddles usually very broad and short, lobes with few marginals.

Engonoceras Neumayr and Uhlig,[28] genotype *E. pierdenale* (Von Buch). Albian-?Cenomanian. Three distinct lines of nodes. Venter flat with nodose edges in earlier stages; broad, often with zigzag outline in later stages. Saddles deeper than in *Protengonoceras* and

[27] Hyatt, Alpheus, Pseudoceratites of the Cretaceous: U. S. Geol. Survey Mon. 44, p. 153, 1903.

[28] Neumayr, Melchior, and Uhlig, Victor, Cephalopoden der Hilsbildungen Norddeutschlands: Palcontographica, vol. 27, p. 12, 1881.

Böhm, Johannes, Über *Ammonites pedernalis* Von Buch: Zeitschr. Deutsch. geol. Gesell., vol. 50, pp. 183–201, pls. 5–6, 1898.

more rounded; lobes with more and deeper marginals; principal saddles sometimes bifid.

Hypengonoceras Spath,[29] genotype *H. warthi* (Kossmatt).[30] Albian. Shell with low folds, elongate marginal nodes, alternating in position along the margins of the flattened venter. Ribs terminating at both ends in small tubercles (according to Stoliczka, but none shows in his figures). Suture relatively complex, with all saddles rounded, bifid and with smaller marginals suggested: lobes with numerous small, pointed marginals.

Parengonoceras Spath,[31] genotype *P. ebrayi* (De Loriol).[32] Albian. Shell with apparently smooth flanks in early stages and with venter truncated and bordered by elongated marginal tubercles; in later stages shows ribs and three rows of lateral nodes. Suture relatively complex, with saddles rounded, bifid, and dissected by many small marginals; lobes with many small blunt marginals.

Metengonoceras Hyatt, genotype *M. inscriptum* Hyatt.[33] Albian. Shell with broad folds in some species; very rarely faint nodes also; usually smooth. Venter in early stages comparatively broad and concave; later narrow but distinctly truncate; still later becomes first acute and then rounded (according to Hyatt, but see below). Suture much like that of some species of *Engonoceras* but rarely has divided saddles.

Epengonoceras Spath,[34] genotype *E. dumbli* (Cragin).[35] Cenomanian-Turonian. Shell with nearly smooth flanks, only low broad folds showing on some shells; venter relatively broad, slightly concave in early stages, becoming narrow (1 to 2 millimeters) but still concave or flat in later stages, and in old age rounded. The shell is not acute at any stage of growth, though the internal molds often are narrowly rounded (see below) in the adult stages and show no reflection of the truncation of the shell. Suture, in general, has the lobes more deeply dissected than in *Metengonoceras*, but the saddles are usually simple as in that genus.

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[29] Spath, L. F., On Cretaceous Ammonoidea from Angola: Roy. Soc. Edinburgh Trans., vol. 53, pt. 1, p. 112, 1922.

[30] Kossmatt, Franz, Untersuchungen über die südindische Kreideformation: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, vol. 9, p. 176, pl. 20, fig. 8, 1895. Stoliczka, Ferdinand, The fossil Cephalopoda of the Cretaceous rocks of southern India, Ammonitidae: Palaeontologia Indica, vol. 1, p. 92, pl. 48, fig. 2, 1865.

[31] Spath, L. F., On a new ammonite (*Engonoceras iris*, sp. n.) from the Gault of Folkstone: Ann. Mag. Nat. Hist., ser. 9, vol. 14, p. 508, 1924.

[32] De Loriol, P., Études sur la faune des couches du Gault de Cosne: Soc. paleont. Suisse Mém., vol. 9, p. 7, pl. 1, fig. 1, 1882.

[33] Hyatt, Alpheus, Pseudoceratites of the Cretaceous: U. S. Geol. Survey Mon. 44, pp. 179–182, pl. 25, figs. 5–9; pl. 26, figs. 1–4, 1903.

[34] Spath, L. F., On a new ammonite (*Engonoceras iris*, sp. n.) from the Gault of Folkstone: Ann. Mag. Nat. Hist., ser. 9, vol. 14, p. 508, 1924.

[35] Hyatt, Alpheus, Pseudoceratites of the Cretaceous: U. S. Geol. Survey Mon. 44, p. 185, pl. 27, figs. 3–14, 1903.

Four of the genera may be instantly excluded from consideration here, but *Metengonoceras* and *Epengonoceras* must be taken into account. The original description of *Metengonoceras* brought forth as its chief characteristic the sharpening of the venter in the middle stages of growth, preceded by a stage with truncated venter and succeeded by a final stage with rounded venter. *Epengonoceras* was separated by Spath for Cenomanian and Turonian species from *Metengonoceras* apparently in the main because of its younger age, for citation of Hyatt's figure and description of the Turonian species "*Metengonoceras*" *dumbli* (Cragin) Hyatt was the only characterization given. These fit in every respect the characterization of the typical Albian *Metengonoceras*. However, Hyatt's description of *dumbli* is in error in the important respect that the venter is not at any stage acute but retains a narrow truncation to a late stage and then becomes rounded. An examination of the specimen figured by Hyatt and cited by Spath is sufficient to convince that it is only the inner mold of the shell that is narrowly rounded, whereas the exterior of the shell itself was channeled or flat on the periphery. Hyatt interpreted a truncation of the latest part of the type preserved as due to injury to the shell, but it appears to the writers as a normal feature. The writers have in hand about a dozen other specimens from the Eagle Ford shale of Texas, which yielded the type, and these show the feature even better than Hyatt's specimen, for much more of the shell is retained, and some specimens even in the internal mold show a distinct ventral facet. The generic description given above is drawn up in accordance with these observations.

The writers have in hand also four specimens figured by Hyatt as *Metengonoceras inscriptum*, including the type of the species and genus, and one, the type, of *M. ambiguum*. All are more or less corroded and deformed, and there is no trace of the shell on any of them. It is not possible to say from these specimens whether the sharp venter of the middle stages is an accident of preservation or an original feature, nor whether the shell was flattened on the venter or sharp. The suggestion is very strong, however, that the shell of these Albian forms also had a narrow, flattened, or concave venter, even though the molds may have been more or less acute. In fact, the front view [36] of the type of *M. inscriptum* given by Hyatt is much restored and the specimen does not show any such straight, sharp ventral edge as his figure presents. On the contrary the venter is irregular, and one part lying between sharpened parts shows a distinct truncation, suggesting that the sharp parts are deformed and the flattened part normal. The writers feel that questions as to *Metengonoceras* must remain unsettled until some one is fortunate

[36] Hyatt, Alpheus, U. S. Geol. Survey Mon. 44, pl. 25, fig. 9.

enough to find good specimens. If it really has, as the writters suggest, a truncated venter the distinction from *Epengonoceras* is very tenuous.

In the meanwhile the writers have accepted *Epengonoceras* as distinct and have referred to it the specimens from the Aspen shale here in question. Spath placed in his genus, beside the genotype, *Sphenodiscus* cf. *pedernalis* (Von Buch) of Grossouvre[37] from the Cenomanian of St. Croix, later named *Metengonoceras douvillei* by Grossouvre.[38] Here probably belong also the Cenomanian form named by Grossouvre[39] *Metengonoceras arnaudi* and the Turonian *M. tolveiense*, both from France. Here would go also Hyatt's *M. acutum*[40] from the Eagle Ford shale of Texas. The range of the genus in Texas appears to be from beds containing true *Acanthoceras* and other Cenomanian forms up into beds containing Turonian species of *Metoicoceras* and other lower Turonian forms.

EPENGONOCERAS ASPENANUM, new species

Plate 1, Figure 15; Plate 2, Figures 2–5; Plate 3, Figures 5–7

This species is based on eight specimens, six of them flattened and somewhat distorted molds of the exterior, one a free fragment of a whorl, and the eighth, chosen as type, a flattened internal mold preserving the beginning of the living chamber and showing the sutures.

The shell was in all probability a much compressed disk as in other species of the genus, though the specimens in hand were so much flattened in preservation that it is not possible to compare the form with that of undistorted material from Texas and elsewhere. The venter of the type at about 40 millimeters diameter is 1.5 millimeters broad and flat with sharp margins; at 60 millimeters it is 1.75 millimeters broad and still flat; at 73 millimeters diameter, the maximum preserved, it is still evidently flattened but the distortion of the specimen makes a measurement valueless. The umbilicus is 5 millimeters wide at the diameter of 70 millimeters and as shown on several paratypes had a rounded shoulder and gently sloping inner wall. Living chamber and aperture not seen.

The surface of the shell, as shown in the type and plaster casts made from the paratypes, was nearly smooth. No nodes are shown and no folds, a few exaggerated growth lines of falcate form being the only ornament. The type and one of the paratypes bore an

[37] De Grossouvre, Albert, Les ammonites de la Craie supérieure: Carte géol. France Mém., Recherches sur la Craie supérieure, pt. 2, Paléontologie, p. 140, text fig. 58, 1894.

[38] De Grosseuvre, Albert, Le Crétacé da la Loire-Inférieure et de la Vendée: Soc. sci. nat. Ouest France Bull., ser. 3, vol. 2, pp. 34–35, pl. 3, fig. 2, text fig. 6, 1912.

[39] De Grossouvre, Albert, idem, pp. 35–37, pl. 3, fig. 4, text figs. 7–8, 1912.

[40] Hyatt, Alpheus, U. S. Geol. Survey Mon. 44, p. 184, pl. 26, fig. 8; pl. 27, figs. 1–2.

overgrowth of oysters, but these seem to have grown upon the shell and not upon an internal mold as in the case of some of the specimens of *Metengonoceras* studied by Hyatt.

The external suture has broad, rather flattened saddles with the first four indented by a tiny marginal lobe. The lobes, on the other hand, are relatively simple, more like those of Albian *Metengonoceras* than like those of *Epengonoceras dumbli.*

The characteristic features of the species in *Epengonoceras* lie largely in the sutures, for form and ornament are so nearly uniform that they offer little assistsance. *E. aspenanum* differs from other American forms in the greater width of the saddles, the small marginals dividing the first four saddles, and in the lesser dissection of the lobes—this is true with respect to species recorded from Texas and several unpublished specimens from the Mowry shale of Wyoming. From the French species noted above it may be separated also by the same features of the suture.

Holotype and paratypes.—Cat. No. 73774, U.S.N.M.

Family SCHLOENBACHIIDAE

Genus ACOMPSOCERAS Hyatt, 1903

Acompsoceras was proposed by Hyatt [41] to receive the genotype *Ammonites bochumensis* Schlüter,[42] *Ammonites essendiensis* Schlüter,[43] and *Ammonites renevieri* Sharpe.[44] Pervinquière [45] included in the genus, besides the species named, *Ammonites sarthensis* Guéranger [46] (including *A. inconstans* Schlüter)[47] and proposed two varieties of *A. essendiensis.*, var. *nurhilense* and var. *madjeurense*, which perhaps are better named as independent species. Spath [48] separated from *Acompsoceras* as *Pseudacompsoceras* Schlüter's *Ammonites inconstans* and *Ammonites coupei* var. Sharpe [49] (not Brongniart), renaming the latter *vectense* and making it the genotype. The conspicuous differences between the genera seem to be in

[41] Hyatt, Alpheus, U. S. Geol. Survey Mon. 44, p. 111.

[42] Schlüter, Clemens, Cephalopoden der oberen deutschen Kreide: Palcontographica, vol. 21, p. 1, pl. 1, figs. 1–4; pl. 2, fig. 1, 1871.

[43] Idem, p. 3, pl. 1, figs. 5–7; pl. 2, fig. 2.

[44] Sharpe, Daniel, Description of the fossil remains of Mollusca found in the chalk of England, part 1, Cephalopoda: Paleontographical Soc. Mon., p. 44, pl. 20, figs. 2 *a, b, c,* 1855.

[45] Pervinquière, Léon, Études de paléontologie tunisienne, pt. 1, Céphalopodes des terrains secondaires, pp. 303–308, pl. 17, 1907.

[46] Guéranger, E., Album palèontologique du départment de la Sarthe (Le Mans), p. 5, pl. 4, fig. 1; pl. 8, fig. 2, 1867.

[47] Schlüter, Clemens, Paleontographica, vol. 21, p. 7, pl. 3, figs. 1–5.

[48] Spath, L. F., On upper Albian Ammonoidea from Portuguese East Africa, with an appendix on Upper Cretaceous ammonites from Maputoland: Annals Transvaal Mus., vol. 11, pt. 3, p. 197, 1925.

[49] Sharpe, Daniel, Paleontographical Soc. Mon., pl. 19, figs. 1 *a–c.*

the presence of several additional rows of nodes on the flanks of *Pseudacompsoceras* and greater curvature of the ribs.

Hyatt placed *Acompsoceras* in the family Mantelliceratidæ. Pervinquière placed it between *Acanthoceras* (*Sharpeiceras*) and *Mammites*, in his discussion suggesting that both *Acompsoceras* and *Mammites* were derived from *Acanthoceras*. Spath assigned both *Acompsoceras* and *Pseudacompsoceras* tentatively to the Schloenbachiidæ.

The genus may be characterized as follows:

Discoidal ammonites with moderately wide umbilicus; large, fold-like costae; marginal and umbilical rows of nodes; venter flattened or somewhat convex, bearing a raised line or "nascent keel." In later stages the flanks became smooth and the venter rounded, the nodes disappear. The external suture has five or six lobes and shows a curvature with the second lateral saddle high; saddles bifid, lobes bifid; siphonal lobe notably shorter than the first lateral lobe.

ACOMPSOCERAS AMERICANUM, new species

Plate 3, figures 1–4

This species is based on a single internal mold, a fragment constituting a little more than one-fourth whorl, accidentally compressed and somewhat distorted but preserving essential characters sufficiently well to deserve a definite assignment and a specific name.

Shell apparently a compressed disk; maximum diameter of type now remaining estimated at 75 millimeters, with part of living chamber preserved. Umbilical shoulder rounded; width of umbilicus not known, but evidently small. Aperture unknown.

Sculpture on septate part of the type consists of fairly sharp primary ribs forking to form low rounded secondary ribs, between which lie intercalated secondary ribs. All these end at the ventral margin in elongated transverse nodes. No umbilical nodes are visible on type. The unseptate part shows only faint growth lines. The ribs and growth lines are gently falcate. The venter was probably gently convex with a low but distinct raised line, rounded on the internal mold. The width of the venter at the maximum diameter of the type (estimated at 75 millimeters) is 9 millimeters, but it may have been reduced a little by the distortion of the shell.

The suture shows bifid lobes and saddles, moderately dissected, short siphonal lobe; first lateral saddle and first lateral lobe subequal in width; second lateral saddle high.

Acompsoceras americanum is characterized by its numerous ribs on the early part, its lack of distinct umbilical nodes, and the lesser dissection of the suture as compared with other species. From *A. bochumense* (Schlüter) it differs in its more numerous ribs, lack of

umbilical nodes, proportions of the suture, and stouter sutural elements, though the degree of dissection is nearly the same; from *A. essendiense* (Schlüter) also by its more numerous ribs and by its less dissected suture; from *A. renevieri* (Sharpe) by its more numerous ribs, shorter siphonal lobe, and stouter sutural elements; from *A. mrhilense* Pervinquière by its less rounded sutural elements and lack of umbilical nodes; from *A. madjeurense* Pervinquière by its coarser ribs, earlier loss of the ribs, and less rounded sutural elements.

This occurrence of *Acompsoceras* does not accord with the current assignment of the genus solely to the Cenomanian. The stratigraphic relations and the associated fossils argue for the lower Turonian age of the present fauna. It is the first record, so far as the writers are aware, of the genus in the United States.

Holotype.—Cat. No. 73775, U.S.N.M.

Family METOICOCERATIDAE Hyatt, 1903

Genus METOICOCERAS Hyatt, 1903

Metoicoceras was instituted by Hyatt [50] in 1903 with *Ammonites swallowi* Shumard [51] as the first species described under the genus and therefore usually considered the genotype. In addition Hyatt described as new *M. gibbosum*, *M. whitei*, and *M. acceleratum*. Hyatt also figured and named *M. kanabense* without description. The genotype species was recorded from the Turonian Eagle Ford shale of Texas, *gibbosum* from Texas, *whitei* from Texas and Utah, *acceleratum* from Texas, and *kanabense* from Utah.

Leriche [52] described *Metoicoceras pontieri* from the base of the Turonian in the north of France, and Grossouvre [53] described, as species of *Mammites*, *Metoicoceras pervinquieri*, *M. gourdoni*, *M. petraschecki*, *M. burcaui*, *M. dumasi*, and with these referred to *Mammites* (*Metoicoceras*) D'Orbigny's *Ammonites geslinianus*.[54] These are assigned to the lower Turonian of western France. Spath [55] later assigned the horizon of *M. pontieri* to the top of the Cenomanian.

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[50] Hyatt, Alpheus, U. S. Geol. Survey, Mon. 44, p. 116.

[51] Shumard, B. F., Descriptions of new Cretaceous fossils from Texas: Acad. Sci. St. Louis Trans., vol. 1, pp. 591–592, 1859.

[52] Leriche, Maurice, Sur la présence du genre *Metoicoceras* Hyatt dans la Craie du Nord de la France et sur une espèce nouvelle de ce genre (*Metoicoceras pontieri*) : Soc. Géol. Nord (France) Annales, vol. 34, pp. 121–124, pl. 2, text figs. 1–3, 1905.

[53] De Grossouvre, Albert, Le Crétacé de la Loire- Inférieure et de la Vendée: Soc. sci. nat. Ouest France Bull., ser. 3, vol. 2, pp. 11–25, pls. 1–2, text figs. 1–2, 1912.

[54] D'Orbigny, Alcid, Paléontologie française, ser. 1, Terrain crétacé, vol. 1, p. 325, pl. 97, figs. 1–2, 1840; Prodrome de paléontologie, vol. 2, p. 146, 1850.

[55] Spath, L. F., On new ammonites from the English chalk: Geol. Mag., vol. 63, p. 80, 1926.

Böse [56] reported *Metoicoceras* as *M.* aff. *whitei* Hyatt and *M.* sp. nov. from beds in Coahuila, Mexico, which he assigned with some doubt to the upper Cenomanian. He also, as Grossouvre had done, assigned *Ammonites geslinianus*, particularly as figured by Petrascheck (*Pulchellia geslinianа*), to *Metoicoceras.*

Reagan [57] described *Metoicoceras wyomingense* from the "Colorado series of the Salt Creek region (Big Horn), Wyoming." It is said to have a broad umbilicus with indefinite shoulders; flattened venter bordered by low, elongated nodes; obscure ribs; no nodes on outer part of flank. The sutures are very ornate for *Metoicoceras* and have two or at most three lateral lobes instead of four or five. The writers doubt that this species belongs to the genus in question, though it is hazardous to make any final judgment on figures only.

Moreman [58] described *Metoicoceras irwini* and figured also *M. whitei* Hyatt, *M. swallowi* (=*M. whitei* variety), and *M. gibbosum* Hyatt, all from the Eagle Ford shale of north Texas.

Metoicoceras may be considered to include ammonites with more or less compressed shells. Umbilicus small, with or without umbilical nodes; ribs near umbilicus may be nearly obsolete if there are no umbilical nodes, or strong, rounded if there are. Ribs somewhat flexed to nearly straight, usually forking on the flank; intercalated secondary ribs common. Outer part of flank usually bears distinct ribs and a row of nodes which forms the inner margin of a ventro-lateral facet. Venter bordered by two rows of elongated nodes and in the earlier stages concave or flattened. In late stages the nodes decrease in prominence, the venter becomes rounded, and the ribs pass across as coarse rounded folds. Living chamber usually scaphitoid in large individuals. Suture relatively simple, ceratitic, consisting of three principal lobes, two principal saddles, all more or less clearly bifid, and a few small auxiliaries.

It may be of interest to characterize briefly the recorded species of *Metoicoceras.*

gibbosum. Whorl relatively stout; umbilicus small, one-eighth the diameter; umbilical nodes weak or lacking; ribs weak on inner part of flank, strong and rather coarse on outer part, ending in moderately strong nodes; ventro-lateral facet well defined, marginal nodes relatively high; suture with saddles indented by numerous small marginal lobes.

swallowi. Whorl not much compressed; umbilical nodes strong, subconical; umbilicus relatively wide, one-fourth the diameter; ribs

[56] Böse, Emil, On a new ammonite fauna of the lower Turonian of Mexico: Texas Univ. Bull. 1856, p. 203, pl. 12, figs. 1–4, 7, 1920.

[57] Reagan, A. B., Cretacic Mollusca of Pacific Slope: Pan-American Geologist, vol. 41, p. 181, pl. 19, figs. 1–2, 1924.

[58] Moreman, W. L., Journ. Paleontology, vol. 1, pp. 92–96, pl. 13, figs. 3, 4; pl. 14, fig. 4; pl. 15, figs. 1, 3, 1927.

strong, ending in strong nodes; ventro-lateral facet well defined; marginal nodes blunt and heavy, becoming later high and sharp; suture with very simple saddles.

whitei. Whorl somewhat compressed: umbilicus small, one-tenth the diameter; umbilical nodes weak, elongated radially; ribs only moderately strong, ending in moderately strong nodes; ventro-lateral facet fairly well defined; marginal nodes only moderately high; suture with saddles indented by numerous small marginal lobes.

"*whitei*" (Kanab, Utah). Whorl somewhat compressed; umbilicus small, one-tenth the diameter; umbilical nodes lacking at all stages; ribs very weak or inner part of flank, becoming stronger towards the periphery and ending in weak nodes; ventro-lateral facet poorly defined; marginal nodes only moderately high; suture with saddles indented by numerous small marginal lobes.

kanabense. (Known only by very small shells.) Whorl much compressed; umbilicus small, one-tenth the diameter; umbilical nodes lacking; ribs weak on umbilical part of flank but visible, becoming stronger towards the periphery and ending in weak nodes; ventro-lateral facet poorly defined; marginal nodes moderately high; suture with saddles indented by numerous small marginal lobes.

irwini. Whorl much compressed; umbilicus small, one-eighth the diameter; umbilical nodes lacking at all stages; ribs lacking on inner part of flank and weak on outer part, ending in obscure nodes; ventro-lateral facet not defined; marginal nodes relatively low; suture with saddles indented by numerous small marginal lobes.

acceleratum. (Known only by very small shells.) Whorl not much compressed; umbilicus small, one-tenth the diameter; umbilical nodes lacking; ribs weak on inner part of flank, becoming stronger on outer part and ending in fairly strong nodes; ventro-lateral facet well defined; marginal nodes apparently blunt, connected by ribs which are not depressed; suture with saddles indented by numerous marginal lobes.

pontieri. Whorls compressed; umbilicus small, one-tenth the diameter; umbilical nodes lacking; ribs very weak near umbilicus, stronger on outer part of flank, ending in very weak nodes; ventro-lateral facet obscure; marginal nodes low; suture seems to have saddles with small marginal lobes.

dumasi. Whorls not much compressed; umbilicus small, one-eighth the diameter; umbilical nodes lacking; ribs weak on inner part of flank, stronger on outer part, ending in weak nodes; ventro-lateral facet fairly well defined; marginal tubercles low but distinct; suture with saddles divided by small marginal lobes.

petrascheeki. Whorl not much compressed; umbilicus moderately wide, one-sixth the diameter; umbilical nodes fairly strong, few in number; ribs fairly strong, ending in moderately strong nodes;

ventrolateral facet well defined; marginal nodes not shown nor described in original publication; suture not shown.

gourdoni. Whorl not much compressed; umbilicus fairly wide, one-fifth the diameter; umbilical nodes strong, few in number; ribs moderately strong, ending in moderately strong nodes; ventrolateral facet well defined; marginal nodes strong; suture apparently with saddles indented by small marginal lobes.

bureaui. Whorl much compressed; umbilicus small, one-eighth the diameter; umbilical nodes lacking; ribs weak on inner part of flank, stronger on outer part, but terminal nodes obscure; ventrolateral facet obscure; marginal nodes low; suture not shown.

geslinianum. Whorl very much compressed; umbilicus relatively wide, one-fourth the diameter; umbilical nodes weak; ribs fairly strong, but no terminal nodes and no ventrolateral facet; marginal nodes low; suture not shown.

pervinquierei. Width of whorls not shown; umbilicus fairly wide, one-fifth the diameter; umbilical nodes few but stout, prominent; ribs moderately strong, ending in weak nodes; ventrolateral facet obscure; marginal nodes fairly strong; suture with saddles indented by numerous small marginal lobes.

METOICOCERAS WHITEI Hyatt

Plate 3, Figure 8; Plate 4, Figures 1–7

1903. *Metoicoceras whitei* (part) Hyatt, U. S. Geol. Survey Mon. 44 p. 122, pl. 14, figs. 1–9, 15 (not pl. 13, figs. 3–5; pl. 14, fig. 10).

1930. *Metoccoceras* aff. *whitei* Hyatt, Böse, Texas Univ. Bull. 1856, p. 203, pl. 12, figs. 4, 7.

1927. *Metoicoceras whitei* Hyatt, Moreman, Journ. Paleontology, vol. 1, p. 92, pl. 13, figs. 3–4.

1928. *Metoicoceras whitei* Hyatt, Adkins, Texas Univ. Bull. 2838, p. 249.

It is the writers' belief that in the species *whitei* as originally defined two forms were included, one represented by the specimens from Kanab Valley, Utah, figured by Hyatt, and those from Utah previously called *Buchiceras swallowi*[59]; the other, the typical *whitei*, by the material figured by Hyatt, apparently from Texas. The doubt as to the latter is introduced by the fact that Hyatt, in the description of his figure, assigns the type specimen to Texas and on page 127 of his paper assigns it to Utah.[60] Inasmuch as C. A. White's *Buchiceras swallowi* was referred to the species and the name was intended to honor Doctor White, it seems possible that Hyatt's type may have come from Utah. However, at the present time one can only accept the plate description as correct, all the more

[59] White, C. A., Report upon the invertebrate fossils collected in portions of Nevada, Utah, Colorado, New Mexico, and Arizona: U. S. Geog. Surveys W. 100th Mer. Rept., vol. 4, pt. 1, p. 202, pl. 20, fig. 1, 1876; Stanton, T. W., The Colorado formation and its invertebrate fauna: U. S. Geol. Survey Bull. 106, p. 168, pl. 37, fig. 1; pl. 38, figs. 1–3, 1893.

[60] A discrepancy present in the original manuscript and not introduced in the editing of this posthumous publication.

as Texan specimens in full agreement with it are abundant. Brief characterizations of the two forms included under *whitei* are given above.

Eight more or less fragmentary molds of the exterior of a species of *Metoicoceras* are here referred to *M. whitei* Hyatt, s. s. The sutures are entirely unknown and the form must be in part inferred because of accidental compression during fossilization. Nevertheless the ornamentation is sufficiently in agreement to warrant the assignment. The ventrolateral facet is not well shown on some of the specimens, but this feature is probably a result of the manner of preservation.

Metoicoceras whitei (in the broad sense) is known at various localities in the Mowry shale of central and eastern Wyoming, the Greenhorn limestone of the Great Plains region and Black Hills, the Mosby sandstone member of the Warm Creek shale of Wyoming, the basal part of the Colorado group of Utah and New Mexico, usually in all these formations in association with *Inoceramus labiatus* Schlotheim and unquestionably of lower Turonian age.

Plesiotypes.—Cat. Nos. 73776, 73777, U.S.N.M.

METOICOCERAS species

Plate 2, Figure 1

A single mold of the exterior of the shell of a small *Metoicoceras* differs from accompanying *M. whitei* in its feeble sculpture and in the development of elongated riblike prominences near the middle of the flank of the outer whorl. This feature does not accord with any described species of *Metoicoceras*, but the writers do not venture to assign a name to the form without more adequate material.

Cat. No. 73778, U.S.N.M.

EXPLANATION OF PLATES

Except for plate 2, Figure 1, and plate 4, Figures 3, 4, and 7, all specimens shown are from the Aspen shale, 80 feet below the top, in the NW.¼ of sec. 32, T. 21 N., R. 115 W., Lincoln County, Wyo. The excepted specimens are from the Aspen shale, 350 feet below the top, in sec. 17, T. 16 N., R. 117 W., Uinta County, Wyo. All figures are natural size except where enlargement is indicated.

PLATE 1

Page

FIGURE 1. *Periplomya? aspenana* Reeside and Weymouth, new species, the holotype, a natural cast of the exterior, U.S.N.M. Cat. No. 73765 .. 7

FIGURES 2, 3. *Anomia* species, two plaster casts from natural molds of the exterior. U.S.N.M. Cat. No. 73764 7

FIGURE 4. *Tellina?* species, view (× 2) of a natural mold of the interior retaining part of the shell. U.S.N.M. Cat. No. 73770 10

FIGURE 5. *Pteria* (*Oxytoma*) species, view (× 5) of a wax squeeze from a natural mold of the exterior. U.S.N.M. Cat. No. 73763 6

FIGURE 6. *Tancredia? lincolniana* Reeside and Weymouth, new species, plaster cast from the holotype, a natural mold of the exterior. U.S.N.M. Cat. No. 73767 8

Page

FIGURES 7, 8. *Aphrodina? aspenana* Reeside and Weymouth, new species. U.S.N.M. Cat. No. 73768 9
7. Plaster cast from the holotype, a natural mold of the exterior retaining parts of the shell.
8. Plaster cast from the paratype, a natural mold of the exterior.
FIGURE 9. *Linearia?* species, a natural cast of the exterior. U.S.N.M. Cat. No. 73769 9
FIGURE 10. *Thracia? wyomingensis* Reeside and Weymouth, new species, the holotype, a natural cast of the exterior. U.S.N.M. Cat. No. 73766 8
FIGURE 11. *Mactra? aspenana* Reeside and Weymouth, new species, view (× 2) of a plaster cast from the holotype, a natural mold of the exterior. U.S.N.M. Cat. No. 73772 11
FIGURES 12, 13. *Mactra? incompta* White? U.S.N.M. Cat. No. 73771 10
12. View (× 2) of a plaster cast from a natural mold of the exterior of a right valve.
13. Plaster cast from a natural mold of two right valves.
FIGURE 14. *Kanabiceras aspenanum* Reeside and Weymouth, new genus and species, plaster cast from the holotype, a natural mold of the exterior. U.S.N.M. Cat. No. 73773 12
FIGURE 15. *Epengonoceras aspenanum* Reeside and Weymouth, new species, plaster cast from a paratype, a natural mold of the exterior. U.S.N.M. Cat. No. 73774 16

PLATE 2

FIGURE 1. *Metoicoceras* species, plaster cast from a natural mold of the exterior. U.S.N.M. Cat. No. 73778 22
FIGURES 2–5. *Epengonoceras aspenanum* Reeside and Weymouth, new species. U.S.N.M. Cat. No. 73774 16
2. Plaster cast from a paratype, a natural mold of the exterior.
3–5. Side view, parts of several sutures (× 2) at a diameter of 60 mm., part of a suture (× 3) at a diameter of 50 mm. of the holotype, a flattened mold of the interior preserving parts of the shell. Several imprints of *Ostrea* species are also shown. (See p. 6.)

PLATE 3

FIGURES 1–4. *Acompsoceras americanum* Reeside and Weymouth, new species, two side views, peripheral view, and suture (× 2) of the holotype, a distorted internal mold of part of a whorl. U.S.N.M. Cat. No. 73775 18
FIGURES 5–7. *Epengonoceras aspenanum* Reeside and Weymouth, new species, U.S.N.M. Cat. No. 73774 16
5. Plaster cast from a paratype, a natural mold of the exterior.
6, 7. Side and peripheral views of a paratype, a fragmentary internal mold preserving the venter.
FIGURE 8. *Metoicoceras whitei* Hyatt, view of a small internal mold. U.S.N.M. Cat. No. 73776 22

PLATE 4

FIGURES 1–7. *Metoicoceras whitei* Hyatt 22
1, 2, 5, 6. Four plaster casts from natural molds of the exterior. U.S.N.M. Cat. No. 73776.
3, 4, 7. Three plaster casts from natural molds of the exterior, from another locality. U.S.N.M. Cat. No. 73777.

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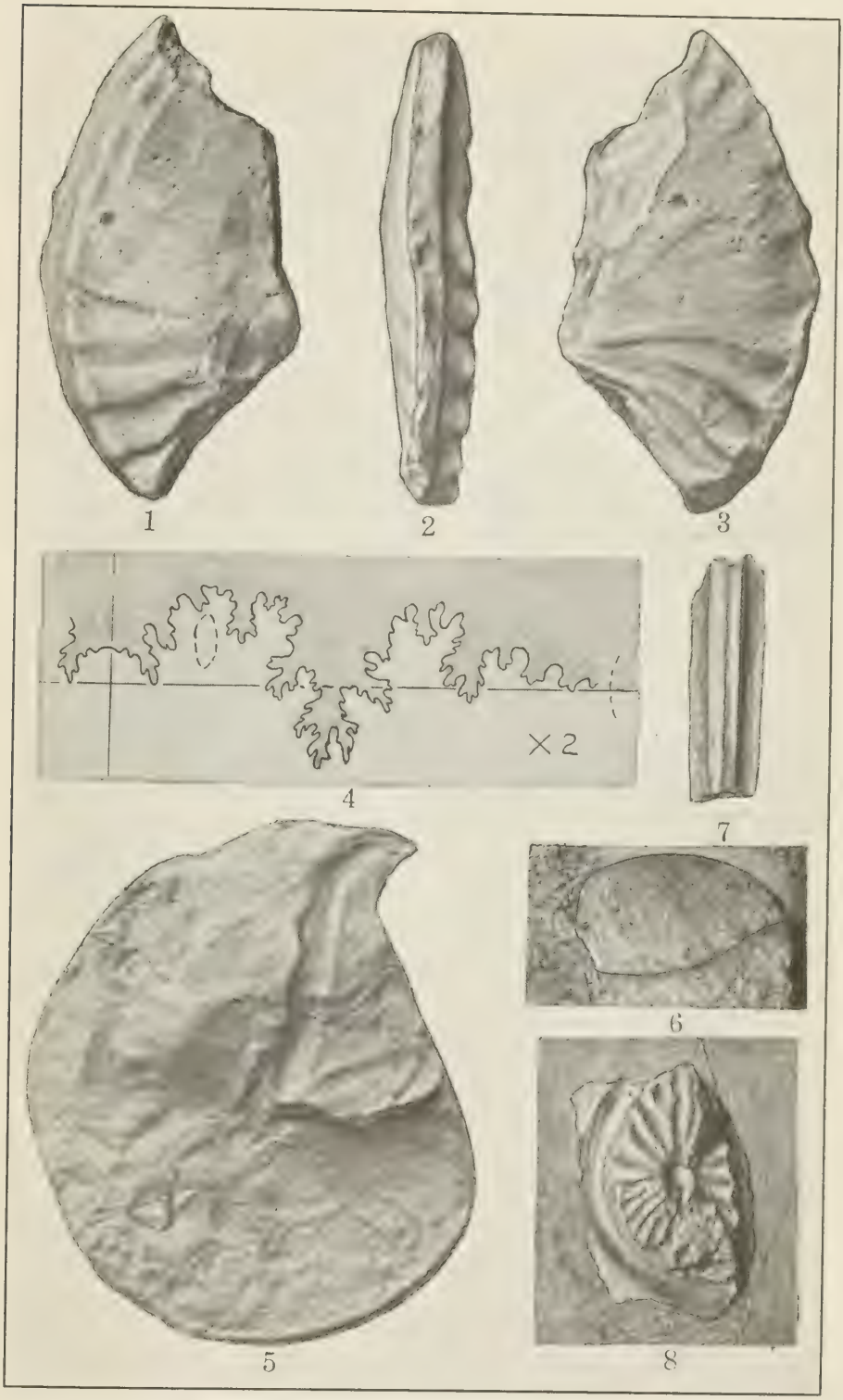
MOLLUSKS FROM THE ASPEN SHALE

FOR EXPLANATION OF PLATE SEE PAGES 23 AND 24

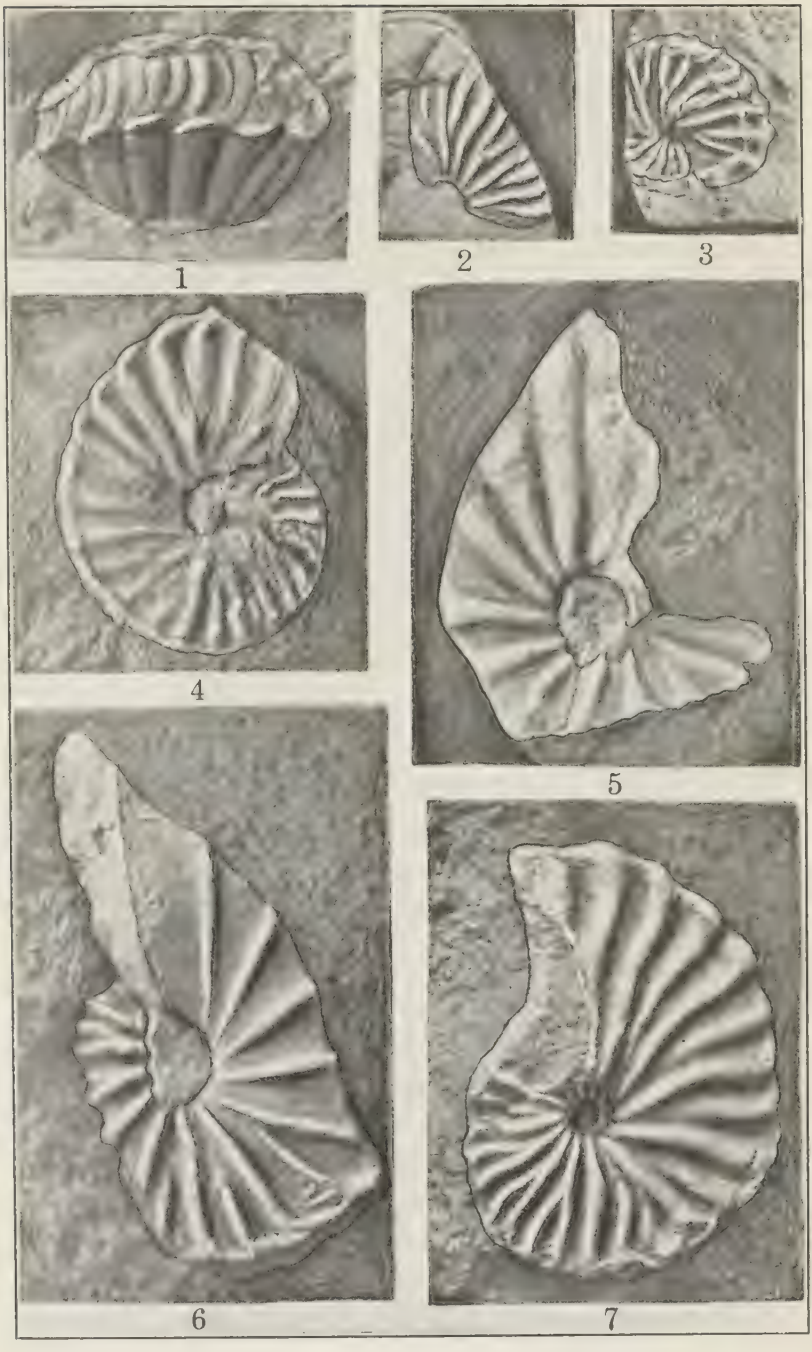
MOLLUSKS FROM THE ASPEN SHALE

FOR EXPLANATION OF PLATE SEE PAGE 24.



MOLLUSKS FROM THE ASPEN SHALE

FOR EXPLANATION OF PLATE SEE PAGE 24.



MOLLUSKS FROM THE ASPEN SHALE

FOR EXPLANATION OF PLATE SEE PAGE 24.

A NEW SPECIES OF AMPHIPOD CRUSTACEAN (ACANTHONOTOZOMATIDAE) FROM CALIFORNIA, AND NOTES ON EURYSTHEUS TENUICORNIS

By Clarence R. Shoemaker

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In the course of a study of some amphipods recently sent to the United States National Museum for identification by the Pacific Biological Laboratories, of Pacific Grove, Calif., two specimens were noticed which represent a new species. This I have named *Panoploca rickettsi* for E. F. Ricketts, director of the Pacific Biological Laboratories. The genus *Panoploca* is now recorded for the first time from the west coast of America.

Eurystheus tenuicornis was described by Prof. S. J. Holmes in 1904 from a single specimen taken in Puget Sound, but has not been recorded by anyone since then. A number of specimens belonging to the genus *Eurystheus* were noted among some amphipod material received from several localities in southern California. Upon detailed examination, I concluded that these specimens belonged with Holmes's species *Eurystheus tenuicornis*, though the old and very mature males exhibited some characters which were not possessed by his specimen. These characters will be discussed under *Eurystheus tenuicornis* (Holmes) in the body of this paper.

PANOPLOEA RICKETTSI, new species

Figures 1–2

Description.—Head, rostrum very long and narrow, front margin with very shallow angle just below the eye, lower front corner bearing two sharply pointed processes. Eye rather large, reniform, colorless in the alcoholic specimens. Antenna 1 a little longer than 2, first joint twice as wide and long as second, which is one-third longer than the third, flagellum nearly twice as long as peduncle and composed of about 13 joints. Antenna 2, fifth joint longer than fourth, flagellum a little longer than peduncle and composed of about 20 joints. Mouth parts all elongate and projecting prominently below

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the side-plates. Upper lip about as broad as long, converging toward the rounding and slightly emarginate apex. Mandible very long and slender, but widening abruptly at the base, apex slightly curved, pointed and bearing a few low teeth on lateral margin, accessory plate originating about half way between molar and apex, very long and slender, and surmounted by a single setule, molar situated about one-third the distance from the base and not very strong, palp situated back of the molar very near the base, and when extended reaching very little beyond the apex of the mandible. Maxilla 1, inner plate bearing four plumose setae, outer plate very long and narrow, and bearing 10 serrate spine-teeth on the very oblique upper margin, palp slender, second joint about one-third longer than first and bearing four or five slender spines on apex. Maxilla 2, inner plate shorter and broader than outer, the very oblique extremity bearing many plumose spines, and the outer plate bearing many long curved distal spines. Maxillipeds, inner and outer plates long and slender, outer plates becoming narrower toward the apex, palp with first joint set at right angle to the plates, and the second and third joints parallel with them, second joint with inner margin produced distally into a broad lobe, second and third joints armed distally with many long spines. Lower lip, outer lobes incised on inner margins near apex, inner lobes wanting, lateral processes long and prominent. Side-plate 1 more rounding distally than 2 or 3, and side-plates 1 to 4 each bearing a few serrations on inner margin near apex. Gnathopods 1 and 2 chelate. Gnathopod 1 very slender and a little longer than 2, fifth joint slightly longer than sixth, seventh joint closing against and exactly fitting palm, end of sixth and seventh joints slightly unguiform. Gnathopod 2 slender but stouter than 1, fifth joint very slightly shorter than sixth, seventh joint closing against and exactly fitting palm which is armed throughout with a row of forward pointing bristles. Side-plates 5 to 7 produced posteriorly to a sharp point. Peraeopods 3 to 5 rather robust and increasing slightly in length consecutively. Peraeopod 3, second joint with lower posterior corner broadly rounding, and upper posterior corner produced to a sharp point, fourth joint with lower posterior corner produced to about the middle of fifth joint. Peraeopod 4, second joint with lower posterior corner produced to a sharp point, and upper posterior corner but slightly produced, rest of limb as in peraeopod 3. Peraeopod 5, second joint with lower posterior corner produced to a sharp point and upper posterior corner broadly rounding, rest of limb as in peraeopods 3 and 4. Peraeon segment 7 and pleon segments 1 to 3 each produced dorsally into two backward projecting teeth. The lower posterior corner of peraeon segment 7 and the upper lateral corner of pleon segments 1 and 2 produced to sharp points. Pleon segment 3 with the upper and lower lateral

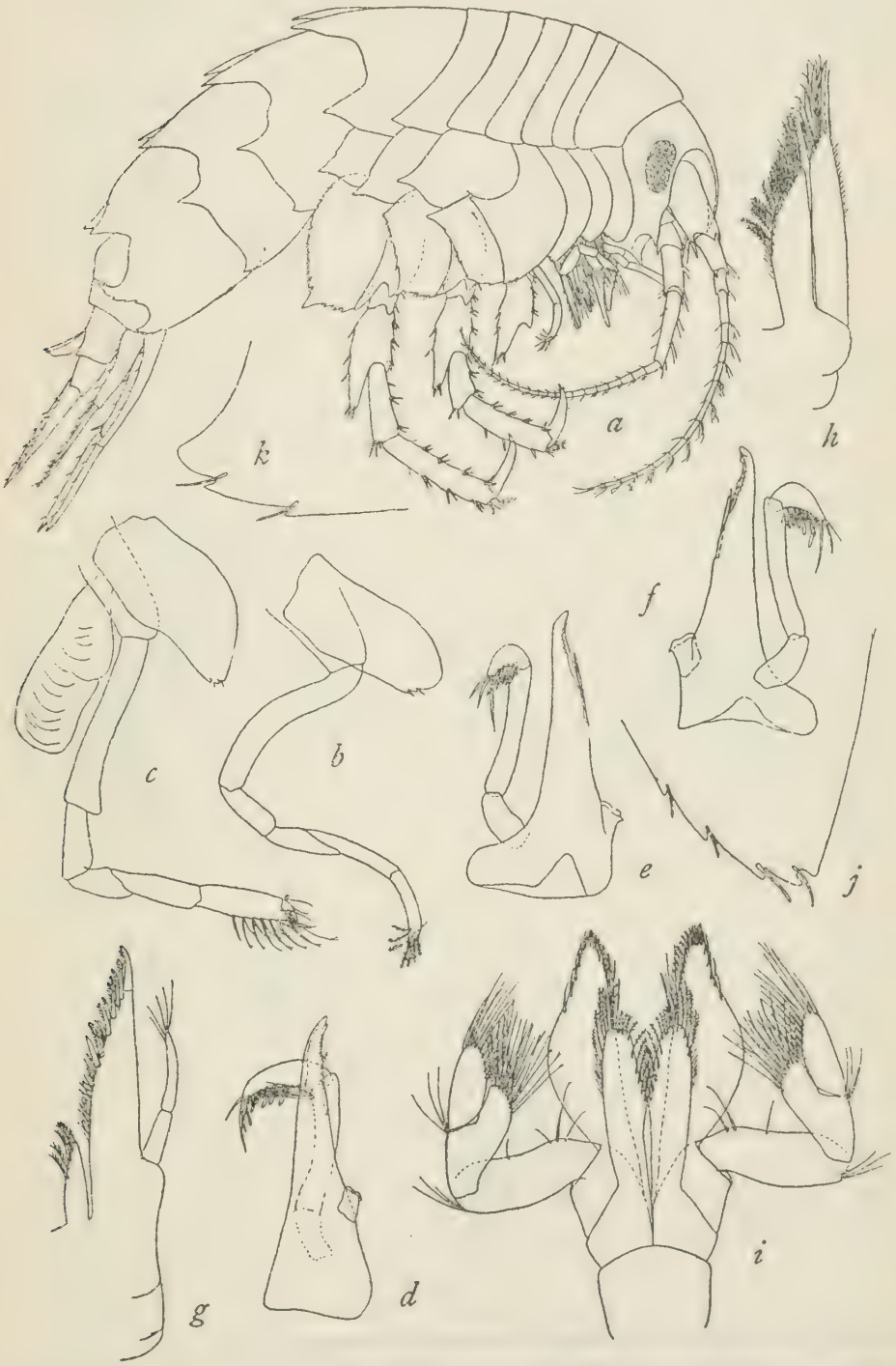

FIGURE 1.—PANOPLOEA RICKETTSI, NEW SPECIES: *a*, ENTIRE ANIMAL; *b*, GNATHOPOD 1; *c*, GNATHOPOD 2; *d–f*, MANDIBLE; *g*, MAXILLA 1; *h*, MAXILLA 2; *i*, MAXILLIPEDS; *j*, SIDE-PLATE 1; *k*, SIDE-PLATE 2

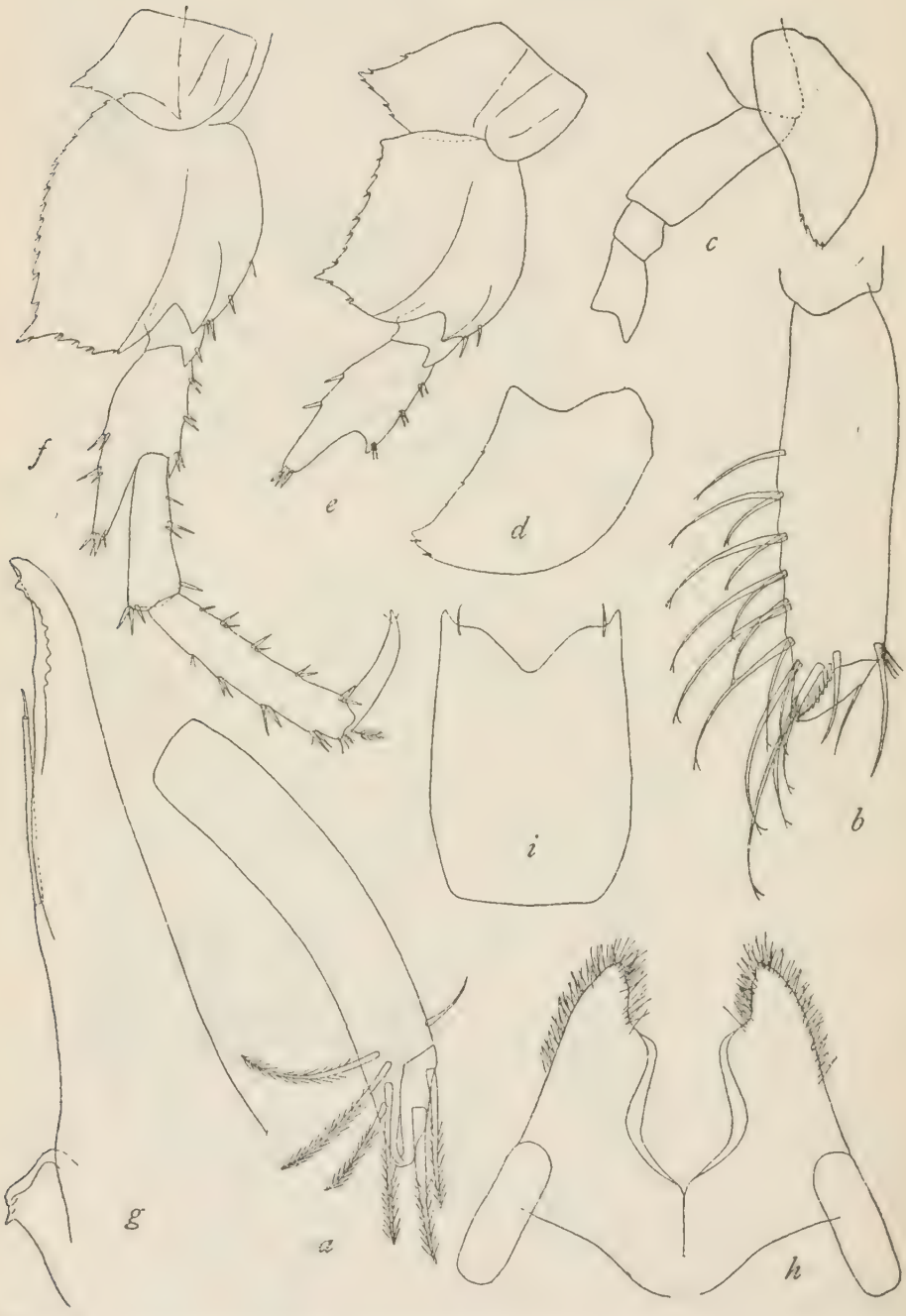

FIGURE 2.—PANOPLOEA RICKETTSI, NEW SPECIES: *a*, GNATHOPOD 1, ENLARGED; *b*, GNATHOPOD 2, ENLARGED; *c*, SIDE-PLATE 3; *d*, SIDE-PLATE 4; *e*, PERAEOPOD 4; *f*, PERAEOPOD 5; *g*, MANDIBLE, ENLARGED; *h*, LOWER LIP, ENLARGED; *i*, TELSON

corners produced into prominent up-turned processes which are serrate on their lower margins. Uropod 1 extending farther back than 2 or 3, which are subequal in length. Outer ramus of all uropods the shorter. Telson a little longer than wide, slightly excavate, and having the lateral corners somewhat produced.

Length.—4.5 mm.

Type.—Cat. No. 63281 U.S.N.M., off Moss Landing, Pacific Grove, Monterey Bay, Calif., taken from rock from 50+ fathoms, collected by the Pacific Biological Laboratories, No. 78.1.

EURYSTHEUS TENUICORNIS (Holmes)

Figures 3–4

1904 *Gammaropsis tenuicornis* HOLMES, Harriman Alaska Expedition: Amphipod Crustaceans of the Expedition, p. 239, fig. 124.

1916 *Podoceropsis concava* SHOEMAKER, Proc. Biol. Soc. Washington, vol. 29, p. 159.

This species was described by Prof. S. J. Holmes from a single immature male specimen from Puget Sound. In 1916 I described a species, *Podoceropsis concava*, from Venice, Southern California. These specimens also were immature, and lacked the antennae. Recently while studying collections from various California localities, containing specimens in all stages of development, I found that old individuals differed greatly from the younger ones in certain characters, and that some individuals exhibited the characters of *Eurystheus tenuicornis* (Holmes), while others possessed those of *Podoceropsis concaca* Shoemaker. There can be no doubt, therefore, that *E. tenuicornis* and *P. concava* are but variations of the same species.

In the younger males the palm of gnathopod 2 is defined by two low teeth, and the sixth joint is very much longer than the fifth. In males of more advanced growth the palm is defined by a single low tooth, and the sixth joint is very little longer than the fifth. In the oldest males the defining tooth of the palm is much more strongly developed, and the central tooth is distinct from the palm and not a mere triangular projection as in younger specimens, while the sixth joint is considerably shorter than the fifth. Gnathopod 2 of the female with palm evenly convex, without defining angle, but possessing two defining spines and having the sixth joint very slightly longer than the fifth. The side-plate of peraeopod 5 in the younger males is of normal proportions, but increases very markedly in size with advancing age until in the old males it attains enormous development and completely covers the second joint of the peraeopod. Pleon segments 2 and 3 with lateral margins strongly convex, and postero-lateral corners indicated by a shallow angle. Pleon segment 4 bears dorsally a backward-pointing tooth and seta on either

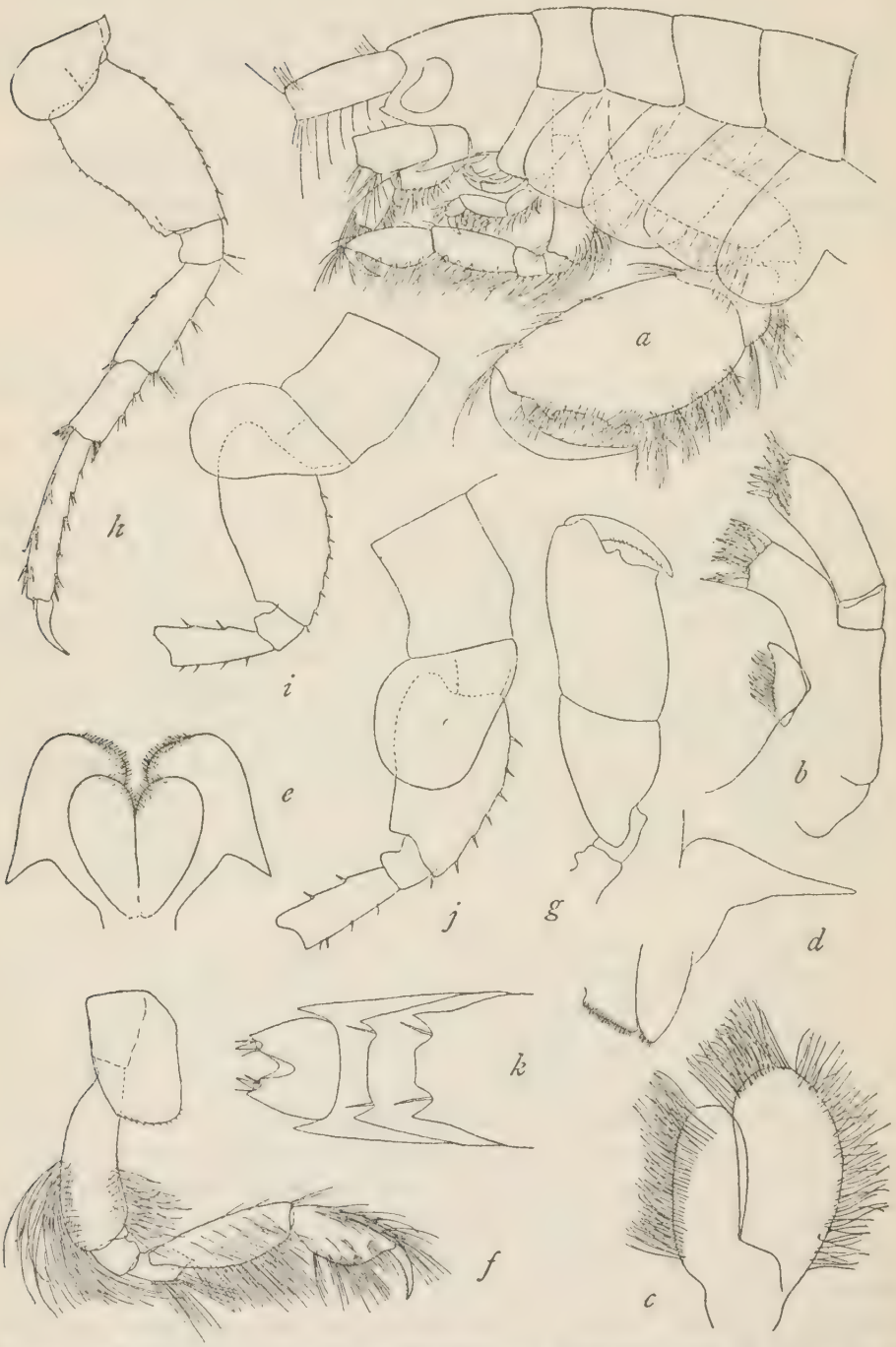

FIGURE 3.—EURYSTHEUS TENUICORNIS (HOLMES): *a*, ANTERIOR HALF OF YOUNG MALE; *b*, MAXILLA 1; *c*, MAXILLA 2; *d*, UPPER LIP; *e*, LOWER LIP; *f*, GNATHOPOD 1, MALE; *g*, GNATHOPOD 2, MALE OF INTERMEDIATE DEVELOPMENT; *h*, PERAEOPOD 5, FEMALE; *i–j*, PERAEOPOD 5 OF MALES SHOWING INTERMEDIATE STAGES OF DEVELOPMENT OF SIDE-PLATE; *k*, DORSAL VIEW OF FOURTH, FIFTH, AND SIXTH PLEON SEGMENTS AND TELSON

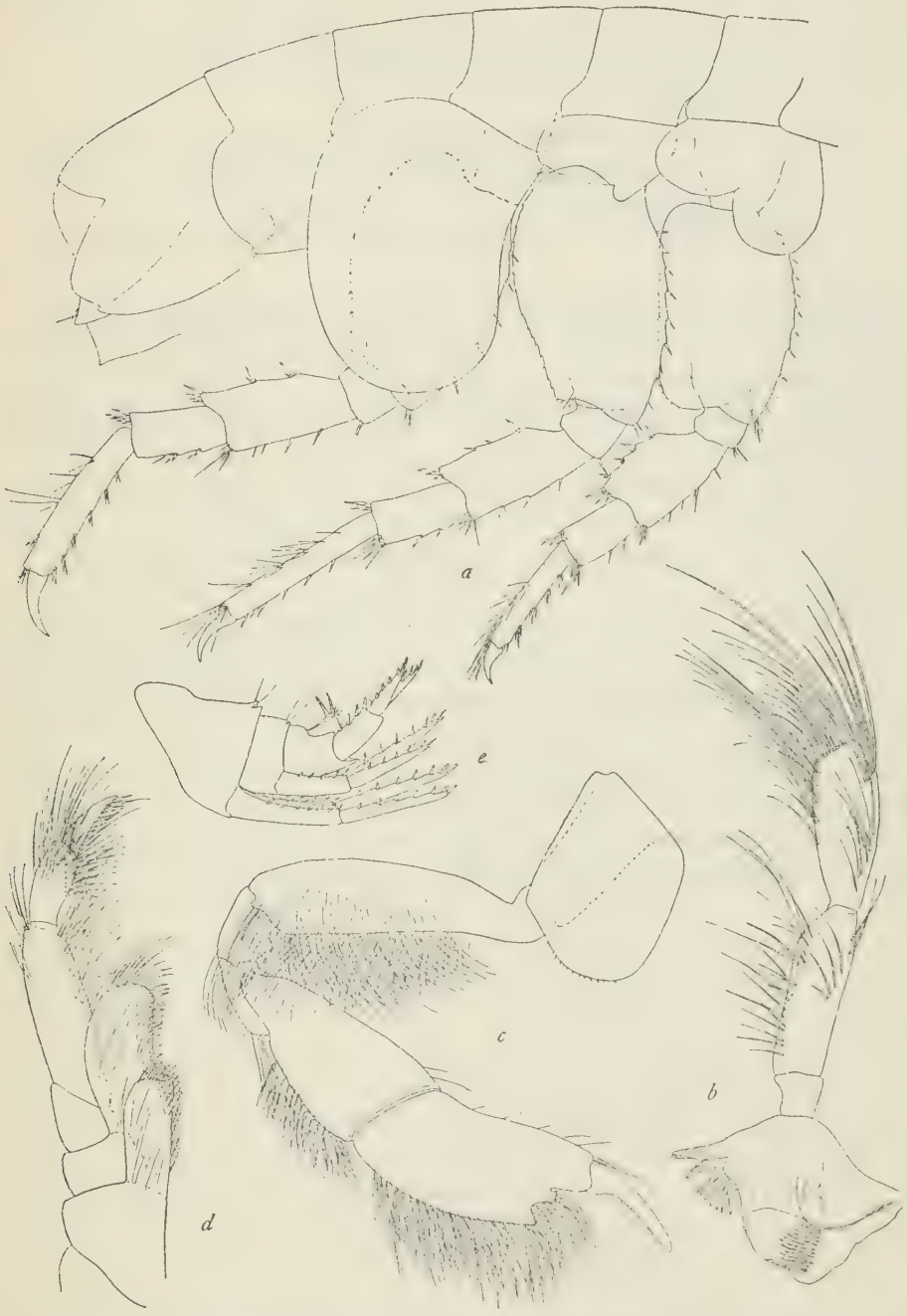

FIGURE 4.—EURYSTHEUS TENUICORNIS (HOLMES): *a*, POSTERIOR HALF OF MALE SHOWING THE GREATEST DEVELOPMENT OF THE SEVENTH SIDE-PLATE; *b*, MANDIBLE; *c*, GNATHOPOD 2 OF FULLY DEVELOPED MALE; *d*, MAXILLIPED; *e*, FOURTH, FIFTH, AND SIXTH PLEON SEGMENTS, TELSON, AND UROPODS OF YOUNG MALE

side of a broad truncate lobe. Pleon segment 5 is armed dorsally as 4 but the lobe between the teeth is low and convex. The epistome is produced far forward into a sharply pointed cone.

The largest specimens measure about 11 mm. in length.

Material examined.—

Gulf of California, *Albatross* station 3024, March 25, 1889, latitude 31° 21′ 00″ N., longitude 113° 49′ 00″ W., 11 fathoms, large beam trawl; about 60 specimens.

San Diego, Calif., 10 fathoms, collected by Henry Hemphill; 8 specimens.

La Jolla, Calif., collected by Scripps Institution; 5 specimens.

La Jolla, Calif., August 28, 1918, collected by Waldo L. Schmitt from kelp hold-fast on beach; 8 specimens.

Laguna Beach, Calif., received from the Laguna Beach Marine Laboratory; 1 specimen.

Venice, Calif., collected by the Venice Marine Laboratory, mostly from the breakwater, 1912 and 1913; 25 specimens.

Santa Monica, Calif., June 16, 1918, collected by E. P. Chase; 1 specimen.

Santa Monica, Calif., collected by F. C. Clark; about 60 specimens.

Monterey Bay, Calif., collected by the Pacific Biological Laboratories, on rocks brought up from 100+ fathoms, March 7, 1928; 1 specimen.

San Francisco Bay, *Albatross* station 5775–*a* off Point Cavallo, 7–4 fathoms, April 16, 1912; 1 specimen.

Golden Gate, San Francisco Bay, Calif., *Albatross* station 5809, 53–21½ fathoms, November 4, 1912; 4 specimens.

NOTES ON THE AMERICAN BATS OF THE GENUS TADARIDA

By H. Harold Shamel

Of the Division of Mammals, United States National Museum

The bats of the genus *Tadarida* [1] were formerly known as *Nyctinomus*. The American forms fall into two groups, one of which was named *Nyctinomops* in 1902 by Miller,[2] who later found that the characters which divide the American species into two groups do not so divide the genus as a whole, when its Old World members are taken into account. The name *Nyctinomops* has therefore been placed in synonymy.[3]

The genus *Tadarida* belongs to the group of bats known as free tail bats, because the tail extends for some distance beyond the edge of the interfemoral membrane. Members of this genus are readily distinguished, externally, from all other American members of the family Molossidae, to which it belongs, by the deep vertical grooves or wrinkles on the upper lip; all the other American genera have smooth upper lips. According to Oldfield Thomas [4] the primary features to be considered in the separation of the skulls of this genus from the skulls of nearly related genera are as follows: First, the definite Z shaped form of the last upper molar (m^3); second the separation of the premaxillae between the upper incisors.

The material examined gives a very satisfactory survey of the genus, so far as its American forms are concerned, except that sufficient specimens of *T. macrotis*, *T. femorosacca*, and *T. aurispinosa* have not been at hand to definitely settle their status. Many more specimens of *T. macrotis* are needed both from North America and South America, and good skulls from the West Indies, before one can decide how many of the names applied to this large *Tadarida* designate valid local forms. Adult skins of *T. femorosacca* are needed to determine whether the apparent difference in color between this form and its South American ally, *T. laticaudata*, is as great as it appears. Specimens are needed from eastern Brazil to decide the

[1] See Lyon, Proc. Biol. Soc. Washington, vol. 27, pp. 217–218, Oct. 31, 1914.

[2] Miller, Twenty new American bats, Proc. Acad. Nat. Sci. Philadelphia, p. 393, Sept. 12, 1902.

[3] Miller, Families and Genera of Bats, Bull. U. S. Nat. Mus., 57, pp. 251–253, June 29, 1907.

[4] Thomas, Journ. Bombay Nat. Hist. Soc., vol. 22, no. 1, pp. 90–91, Apr. 21, 1913.

real status of *T. aurispinosa*, the type and only known specimen of which has no skull. The differences in this skin from skins of *T. laticaudata* are very slight.

It might be well to observe here that the type of *Nyctinomus orthotis* proves to be a *Eumops* [5] and that *Nyctinomus kalinowskii* is now placed in the genus *Mormopterus*.[6]

All specimens of the genus *Tadarida* in the American Museum of Natural History, New York City, as well as all South American specimens of the genus in the Field Museum of Natural History, Chicago, have been examined. Specimens listed, that are not followed by abbreviations, are the property of the United States National Museum. The abbreviations F. M. stand for the Field Museum, Chicago, and A. M. N. H. stand for the American Museum of Natural History, New York. My thanks are extended to Mr. H. E. Anthony, of the American Museum of Natural History, New York City, and to Dr. W. H. Osgood, of the Field Museum of Natural History, Chicago, for the loan of specimens under their charge.

KEY TO THE AMERICAN BATS OF THE GENUS TADARIDA

First or *brasiliensis* group.—Second phalanx of fourth finger long, 6.6–9.2 mm.; ears extending to or falling short of end of rostrum when laid forward, inner edges not united at base; slight indication of pocket in membrane at the angle of femur and tibia; skull with broad flat rostrum, considerably wider anteriorly than at point of least interorbital breadth; weak sagittal crest; upper incisors strongly converging at tips.

Ear not reaching end of rostrum when laid forward.

Total length of skull 17.0 mm. or over ..... **cynocephala**, p. 7

Total length of skull always under 17.0 mm.

Forearm 40.0–42.5 mm ..... **murina**, p. 9

Forearm 36.6–41.4 mm ..... **antillularum**, p. 10

Ear extending to end of rostrum when laid forward.

Total length of skull never over 16.2 mm.; transverse area of maxillary teeth smaller ..... **intermedia**, p. 7

Total length of skull always 16.2 mm. or over; transverse area of maxillary teeth larger.

Forearm frequently under 40.0 mm ..... **muscula**, p. 9

Forearm always 40.0 mm. or over.

Breadth at m^2 frequently reaching 7.0 mm.

Forearm 42.2–46.4 mm ..... **brasiliensis**, p. 3

Forearm 41.6–43.8 mm ..... **constanzae**, p. 10

Breadth at m^2 always less than 7.0 mm.

Color lighter, verona brown ..... **bahamensis**, p. 8

Color darker, mummy brown ..... **mexicana**, p. 4

Second or *macrotis* group.—Second phalanx or fourth finger short, 2.0–4.4 mm.; ears extending well beyond end of rostrum when laid forward, inner edges united at base for about 2 mm.; well-developed pocket in membrane at angle of femur and tibia; skull with slender rostrum, scarcely wider anteriorly than

[5] Miller, Proc. Biol. Soc. Washington, vol. 19, p. 85, May 1, 1906.

[6] Miller, Bull. U. S. Nat. Mus., 57, p. 254, 1907.

at point of least interorbital breadth; prominent sagittal crest; upper incisors parallel.

Forearm always 58.0 mm. or over.

Total length of skull 22.2–24.0 mm ..... **macrotis**, p. 15

Forearm 50.0 mm. or less.

Tibia over 15.0 mm ..... **aurispinosa**, p. 11

Tibia less than 15.0 mm.

Total length of skull 18.0 mm. or over.

Occipital depth of skull 6.4–7.0 mm ..... **laticaudata**, p. 12

Occipital depth of skull 6.0–6.4 mm ..... **femorosacca**, p. 13

Total length of skull usually 18.0 mm. or less.

Basal length 13.5–14.2 mm ..... **europs**, p. 14

Basal length 14.6–15.2 mm ..... **yucatanica**, p. 15

BRAZILIENSIS GROUP

The skulls in this group are characterized by their broad, flat muzzle, which is considerably wider anteriorly than at the point of least interorbital breadth; weak sagittal crest posteriorly; upper incisors widely separated at their base by an anterior palatal emargination, and converging strongly toward their tips. Lower incisors normally six; but occasionlly only five or four. The outer incisors are very small and are much crowded against the canines, sometimes absent on one side or both. Their absence is most frequent in very young or very old individuals.

At the angle of the tibia and femur there is a small fold of skin on the underside. The nasal border bears a series of rounded spines; this series is continued as a single line descending between the nasal apertures. This descending line never divides at the base into two branches as it does in the *macrotis* group. The tragus is truncate; antitragus low, wider than high. In all South American specimens of *T. brasiliensis*, the ear reaches the end of the nostril, when laid forward, as it also does in *T. intermedia*, *T. mexicana*, *T. bahamensis*, *T. muscula*, and *T. constanzae*. In *T. cynocephala*, *T. antillularum*, and *T. murina* it falls short by about 2 mm. of the end of the rostrum when laid forward. Ears in immature members of this genus are always much shorter than those of the adult.

The second phalanx of the fourth finger is long, 6.6–9.2 mm. in all the specimens measured, or about three times as long as the first phalanx of the same finger. When compared with the length of the forearm it is found to range from 15 per cent in *T. murina* to 19.5 per cent in *T. cynocephala*.

TADARIDA BRASILIENSIS (I. Geoffroy)

1824. *Nyctinomus brasiliensis* Geoffroy, Ann. Sc. Nat., vol. 1, p. 337.

1827. *Dysopes nasutus* Temminck, Monogr. Mamm., vol. 1, pp. 233–234 (Brazil.)

1840. *Dysopes naso* Wagner, Schreb. Säugeth. suppl., vol. 1, pp. 475–476 (Brazil.)

1864. *Nyctinomus nasutus* H. Allen, Monogr. Bats. N. Amer., p. 7, figs. 6, 7 (part).

1878. *Nyctinomus brasiliensis* DOBSON, Catal. Chiropt. Brit. Mus., pp. 437–439 (part).

1920. *Tadarida brasiliensis* THOMAS, Proc. U. S. Nat. Mus., vol. 58, p. 222. November 10, 1920.

Type locality.—Curityba, Parana, Brazil. In the original description of the species *T. brasiliensis*, I. Geoffroy selects no single specimen from Brazil as the type, but mentions seven specimens from the Province of Missiones and four specimens from the district of Curityba, Province of Parana. Since I have been able to examine six specimens from the province of Parana, I select Curityba as the type locality in order to fix the name on a definite form.

Measurements taken by Mr. Miller in 1904 from a mounted specimen in the Paris Museum marked "Type, Brazil," are as follows: Tail, 36; tibia, 13; foot, 9.4; forearm, 43.8. These measurements all fall within the limits of variation of the measurements of specimens from Parana, as may be seen by comparing them with the table of external measurements on page 18.

Geographic distribution.—From Costa Rica through South America as far south as central Chili.

Diagnosis.—*T. brasiliensis* averages slightly larger than any other form in the *brasiliensis* group. The tibia is, with one exception, constantly over 12.0 mm. in all specimens measured, while the total length of the skull in all but one instance is 17.0 mm. or over. The color of the few skins examined is not different from that of North American forms, except that some skins from Tucuman, Argentina, and also some from Peru show a light sprinkling of white hairs on the back.

Measurements.—For detailed measurements see tables, pages 18 and 23.

Specimens examined.—Seventy-one from the following localities: **Costa Rica**: San Jose, 1 skin; **Venezuela**: 1 skin (A. M. N. H.); **Brazil**: Cidadeda Barra (Rio S. Francisco, Bahia), 3 alcoholics (F. M.); Province of Parana, 6 alcoholics; **Uruguay**: Maldonada, 6 skins (F. M.) Paysandu, 1 alcoholic; Polaneo, 1 skin (F. M.), 1 skin; no exact locality, 4 alcoholics; **Paraguay**: Villa Rica, 2 skins, 5 alcoholics; **Argentina**: Tucuman, 4 skins, 1 alcoholic; Mendoza, 1 alcoholic; **Peru**: Matchu Picchu, 4 skins; Santa Ana, 2 skins, 22 alcoholics; Lima Surco, 1 skin; **Chili**: Temuco, 1 alcoholic, 2 skins (F. M.), 2 skins (A. M. N. H.); Ramal de Melepilla, 1 alcoholic; Palmilla, La Cruz, 1 skin (F. M.); Province of Valdivia, 1 skin (F. M.), Province Aconcaqua, Papuda, 1 skin (F. M.).

TADARIDA MEXICANA (Saussure)

1860. *Molossus mexicanus* SAUSSURE, Revue et Magasin de Zoologie, ser. 2, vol. 12, p. 283, July, 1860.

1864. *Nyctinomus nasutus* H. ALLEN, Monogr. Bats N. Amer., Smiths. Miscell. Coll., no. 165, pp. 7–10, June, 1864 (part).

1878. *Nyctinomus brasiliensis* Dobson, Catal. Chiropt. Brit.-Mus., pp. 437–439 (part).

1889. *Nyctinomus mohavensis* Merriam, N. Amer. Fauna, no. 2, p. 25, October 30, 1889.

1894. *Nyctinomus brasilinensis californicus* H. Allen, Monogr. Bats N. Amer., Bull. U. S. Nat. Mus., 43 (1893), p. 166, March 14, 1894.

1918. *Nyctinomus mexicanus* H. Grinnell, A Synop. Bats Calif., Univ. Calif. pub. zool., vol. 17, pp. 361–369, January 31, 1918.

1924. *Tadarida mexicana* Miller, N. Amer. Recent Mamm. 1923, Bull. U. S. Nat. Mus. 128, p. 86, April 29, 1924.

Type locality.—Ameca, Jalisco, Mexico. The describer selects no specimen as type, but gives as the habitat the plateau of Mexico. Specimens are mentioned from Ameca, Jalisco, and from Cofre de Perote, Vera Cruz. In the United States National Museum collection are three specimens from San Pedro, Jalisco, which is in the immediate vicinity of Ameca, and 23 others from various places in Jalisco. I have therefore chosen Ameca, Jalisco, as the type locality. A specimen labeled, "Mexico" (Saussure) and marked type of *Mollossus mexicanus* was examined in the Berlin Museum in 1904 by Mr. Miller who thinks that it is probably a cotype. Measurements were taken at the time as follows: Total, 91; tail, 32.6; tibia, 12; foot, 9; forearm, 41.6; ear from meatus, 19; ear from crown 15. Adult male.

Geographic distribution.—Mexico, Texas, New Mexico, Arizona, California, Lower California, Utah, and Oregon.

Diagnosis.—The forearm is 40.4–46.6 mm. in length, usually ranging somewhere between 42 and 44 mm. It only seldom reaches 45 and rarely goes below 42. Length of tibia from 11.4–13.0 mm., average about 12. Length of skull 16.2–17.8 mm., usually 16.2–17.4. Ear extends to end of nostril when laid forward. When the skulls are compared with those of *T. brasiliensis* the greatest difference is seen to be the narrower rostrum in the Mexican form. In 18 skulls of *T. brasiliensis* the width at m^2 ranges from 6.8 to 7.2 mm.; while in 50 skulls of *T. mexicana* the width at m^2 ranges from 6.2 to 6.8 mm. In only one of the South American skulls measured is the total length under 17.0 mm., while in *T. mexicana* it is frequently less than 17.0 mm. The tibia averages somewhat shorter than that of *T. brasiliensis*.

Measurements.—For detailed measurements see tables, pages 18 and 24.

Specimens examined.—Seven hundred twenty-two from the following localities: **Mexico** (285): Puebla, 3 skins, 14 alcoholics; Vera Cruz, 3 skins; Morelos, 2 skins, 10 alcoholics; Lerma, 2 skins, 23 alcoholics; Tacubaya, 6 skins, 18 alcoholics; Hidalgo, 1 skin, 2 alcoholics; Michoacan, 6 skins, 32 alcoholics; Colima, 76 alcoholics; Chapala, 1 alcoholic; Jalisco, 26 alcoholics; Queretaro, 5 alcoholics; Guanajuato, 24 alcoholics; San Luis Potosi, 83 alcoholics; Zacatecas, 4

skins, 20 alcoholics; Tamaulipas, 1 skin; Durango, 1 alcoholic; Sinaloa, 1 alcoholic; Nuevo Leon, 1 skin; Coahuila, 17 skins; Chihuahua, 2 skins 1 alcoholic; Sonora, 1 skin; Rio Pecos to Rio Grande Rivers, 1 alcoholic; San Pedro, 1 alcoholic: no exact locality, 1 alcoholic. **Texas** (257): Brownsville, 10 alcoholics; Hidalgo, 1 alcoholic; Laredo, 1 skin; Padre Island, 1 alcoholic; Runge, 2 skins; Eagle Pass, 9 alcoholics; Uvalde, 9 alcoholics; Del Rio, 4 skins; Comstock, 136 skins; Langtry, 2 skins; Valverde County, 12 alcoholics; Fort Clark, 4 skins; Victoria, 3 alcoholics; San Antonio, 1 skin, 1 alcoholic; Austin, 2 alcoholics; Kerrville, 5 skins, 9 alcoholics; San Angelo, 1 alcoholic; Burnet, 1 alcoholic; Brazos, 8 skins, 10 alcoholics; Fort Stockton, 3 skins, 1 alcoholic; Alpine, 2 alcoholics; Boquillas, 1 alcoholic; Davis Mountains, 3 skins; El Paso, 1 skin; Mitchell Lake (near San Antonio), 1 alcoholic; no exact locality, 13 alcoholics. **New Mexico** (17): Carlsbad, 4 skins, 3 alcoholics; Las Vegas, 1 alcoholic; San Mateo Mountains, 1 skin; Deming, 1 skin; Mimbres Range to the Rio Grande, 1 skin; Animas Valley, 2 skins; Cloverdale, 4 skins. **Arizona** (44): San Bernardino Ranch, 4 skins, 2 alcoholics; Parker, 1 skin, 1 alcoholic; York, 1 alcoholic; Safford, 1 skin; White Rive, 1 alcoholic; Grand Falls, Little Colorado River, 7 alcoholics; Tucson, 1 alcoholic; Pima County, 1 skin; Fort Mohave, 1 skin; Yuma, 4 skins, 19 alcoholics; Colorado River, Diamond Creek, 3 alcoholics. **California** (109): Fort Yuma, 1 alcoholic; Carrizo Creek, San Luis Rey, San Diego County, 5 alcoholics; Covina, 1 skin; Los Angeles, 1 alcoholic; Pasadena, 1 skin; Alhambra, 4 alcoholics; Bear Valley, San Bernardino County, 4 alcoholics; 29 Palms, San Bernardino County, 1 skin; Cloverdale, 4 alcoholics; Buttonwillow, 1 skin; Lemoore, 19 alcoholics; San Jose, 4 alcoholics; Monterey, 1 alcoholic; Santa Cruz, 4 alcoholics; Death Valley, Inyo County, 8 alcoholics; Three Rivers, 13 alcoholics; Chinese Camp, Tuolumne County, 2 alcoholics; Auburn, 1 alcoholic; Gilroy, 1 skin; Colusa, 12 skins, 13 alcoholics; Chico, 5 skins, 3 alcoholics. **Utah**: Jensen, 1 alcoholic. **Oregon**: Fort Dallas, 1 skin. **Lower California** (10, A. M. N. H.): Carrizo, 1 alcoholic; San Pedro Martir, 2 alcoholics; San Telmo, 6 alcoholics; Villadares, 1 alcoholic.

Remarks.—This species is plentifully represented in the United States National Museum collection. Its range covers a territory in Mexico on the south from the State of Pueblo north to central Texas (Austin on the east, and as far north as Brazos, Palo Pinto County), thence west through New Mexico, Arizona, Utah (northeastern), and from southern California north to Chico in Butte County and Fort Dallas, Oreg. This bat has a remarkably extensive range for a single species and varies only slightly in intensity of color, mummy brown to Prout's brown (Ridgway 1912). These variations are never localized, and dark and light examples can be matched from almost any two localities.

TADARIDA INTERMEDIA, new species

Type.—Adult male (in alcohol), Cat. No. 78488, U.S.N.M., Biological Survey Collection. Collected in the Valley of Comitan, Chiapas, Mexico, December 11, 1895, by E. W. Nelson and E. A. Goldman.

Distribution.—Tropical zone in Southern Mexico and Guatemala.

Diagnosis.—Skull and teeth smaller than in *T. mexicana;* greatest length of skull 15.5–16.2 mm. instead of 16.2–17.8 mm. Ear extends to end of nostril when laid forward.

Teeth.—The molariform teeth are smaller in transverse extent than those of *T. mexicana* or *T. brasiliensis.* The length of the maxillary tooth row is 5.5–6.0 mm. instead of 5.8–6.5 mm. and 6.0–6.6 mm., respectively, in these two related forms.

Measurements.—Type: Head and body, 52.4; tail, 27.6; tibia, 12.8; foot, 8.8; forearm, 45.0; third metacarpal, 44.6; fifth metacarpal, 26.4; thumb, 6.5; ear from meatus, 16.0; ear from crown, 12.8; ear width, 15.2; total length of skull, 15.8; zygomatic breadth, 8.5; interorbital breadth, 3.8; occipital depth, 5.8; breadth of braincase, 7.8; basal length, 13.2; maxillary tooth row (including incisor), 5.6; breadth at m^2, 6.4; breadth at canines, 3.6; length of mandible, 11.4; length of maxillary tooth row, 6.2. For measurements, see pages 18 and 24.

Specimens examined.—Fourteen from the following localities: Chiapas, Valley of Comitan, 11 alcoholics including the type; Guatemala, Jacatlenango, 3 alcoholics.

Remarks.—This bat is not different from *T. mexicana* in outward appearance or external measurements, but the skulls run smaller in all their measurements, their uniformly less size being at once noticeable when specimens are laid out in a series. The range is intermediate between *T. mexicana* and *T. brasiliensis*, but the characters are not.

TADARIDA CYNOCEPHALA (LeConte)

1831. *Nycl* [*icea*] *cynocephala* LeConte, McMurtrie's Cuvier, Animal Kingdom, vol. 1, p. 432.

1837. *Molossus fuliginosus* Cooper, Ann. Lyc. Nat. Hist. New York, vol. 4, pp. 67–68, pl. 3, figs. 3–4. November, 1837.

1855. *Rhinopoma carolinense* LeConte, Proc. Acad. Nat. Sci. Philadelphia, vol. 7, pp. 437–438.

1864. *Nyctinomus nasutus* H. Allen, Mon. Bats N. Amer., Smiths. Miscell. Col., no. 165, pp. 7–10, June, 1864 (part).

1893. *Nyctinomus brasiliensis* H. Allen, Mon. Bats N. Amer., Bull. U. S. Nat. Mus., no. 43, pp. 163–171 (part).

1898. *Nyctinomus cynocephalus* Miller, Proc. Boston Soc. Nat. Hist., vol. 28, p. 218, March, 1898.

1924. *Tadarida cynocephala* Miller, N. Amer. Recent Mamm. 1923, Bull. U. S. Nat. Mus. 128, p. 85, April 29, 1924.

Type locality.—Georgia, probably in the neighborhood of the LeConte plantation, Liberty County. Type specimen not known to be in existence.

Geographic distribution.—Louisiana, Alabama, Florida, Georgia, and South Carolina.

Diagnosis.—The skull, which is constantly 17.0 mm. or over in its total length, is like its South American ally *T. brasiliensis;* but larger than *T. mexicana* whose skull is usually less than 17.0 mm. The uniformly short tibia and ear are the most reliable characters to separate it from both *T. brasiliensis* and *T. mexicana.* The color runs more uniformly toward the darker shade for the genus.

Measurements.—For detailed measurements see tables, pages 20 and 25.

Specimens examined.—Two-hundred fifty-eight specimens from the following localities: **Louisiana:** Houma, 77 alcoholics; New Orleans, 33 alcoholics. **Alabama:** Orange Beach, 1 skin; Greensboro, 30 alcoholics. **Georgia:** Savannah, 1 skin, 1 alcoholic. **Florida:** Gainesville, 20 skins, 74 alcoholics; Kissimmee, 1 skin; Wacissa River, 1 skin; southern Florida, 1 skin; no exact locality, 10 alcoholics. **South Carolina:** Columbia, 8 skins.

WEST INDIAN FORMS

Taken as a whole the Antillean members of the genus *Tadarida* are smaller than the mainland forms. The differences that I have been able to find, among these island forms themselves, are in averages rather than individual measurements. The insular forms divide reasonably well into two groups, a southern group including those found on the islands from Dominica up to and including Porto Rico, a northern group including those found on the islands of Jamaica, Hispaniola, Cuba, and the Bahamas. In the northern group the skull ranges in total length from 16.0–16.8 mm., or always 16.0 mm. or over. In the southern group the total length of the skull ranges from 14.6–16.5 mm. (usually less than 16.0 mm.). The ear in members of the northern group is longer, extending, in alcoholic specimens, to the edge of the nostril when laid forward. This last statement is not true of the Jamaican form, as it has a short ear, but I have placed it in the northern group because of the uniformly larger skull. In the southern group the ear is shorter; it fails to reach the edge of the nostril by about 2 mm. when laid forward.

TADARIDA BAHAMENSIS (Rehn)

1902. *Nyctinomus bahamensis* Rehn, Proc. Acad. Nat. Sci. Philadelphia, p. 641, December 12, 1902.

1911. *Nyctinomus brasiliensis bahamensis* G. M. Allen, Bull. Mus. Comp. Zoöl., vol. 59, p. 245, July, 1911.

1923. *Tadarida bahamensis* Miller, N. Amer. Recent Mammals 1923, Bull. U. S. Nat. Mus. 128, p. 85, April 29, 1924.

Type locality.—Governor's Harbor, Eleuthera, Bahamas. Type specimen in the collection of the School of Biology, University of Pennsylvania.

Geographic distribution.—Bahama Islands, Eleuthera Island, Long Island, and Little Abaco Island.

Diagnosis.—Size largest of the West Indian forms; forearm 40.0–43.6 mm., usually, 41.0 mm. or over; length of tibia, 12.0–12.8 mm., usually over 12.0 mm.; length of skull, 16.5–16.8 mm.; color lighter, about Verona Brown (Ridgway, 1912).

Measurements.—For detailed measurements see tables, pages 20 and 25.

Specimens examined.—Eighty-five specimens, all alcoholics, except five skins, from Clarence Harbor, Long Island, Bahama Islands.

TADARIDA MUSCULA (Gundlach)

1840. *Rhinopoma carolinensis* Gundlach (not Geoffrey), Wiegm. Archiv., vol. 1, p. 358

1861. *Nyctinomus musculus* Gundlach, Monatsber, k. preuss. Akad. Wissensch. Berlin, p. 149

1924. *Tadarida muscula* Miller, N. Amer. Recent Mammals 1923, Bull. U. S. Nat. Mus. 128, p. 86, April 29, 1924.

Type locality.—Cuba. Mr. Miller, while in the Berlin Museum in 1904 found six specimens of *T. muscula.* A mounted specimen and a bottle containing four in alcohol were marked type. Measurements taken at that time of an adult male in alcohol are as follows: Total length, 85; tail, 31; tibia, 10.4; foot, 7; forearm, 38; ear from meatus, 16; ear from crown, 13.

Geographic distribution.—Cuba.

Diagnosis.—This bat is separable from *T. bahamensis* by its shorter tibia, 11.0–12.2 mm. as against 12.0–12.8 mm., and its darker color. From *T. murina* by its longer ear, 16.2–17.5 mm. as against 15.0–16.2 mm., and its average shorter forearm. From *T. constanzae* by its average shorter forearm, 38.2–41.2 mm. as against 41.0–43.0 mm.

Measurements.—For detailed measurements see tables, pages 20 and 26.

Specimens examined.—Twenty-three from the Island of Cuba, including 16 alcoholics and 7 skins.

TADARIDA MURINA (Gray)

1827. *Nyctinomus murinus* Gray, Cuvier's Animal Kingdom, Griffith edition, vol. 5, p. 66

1861. *Nyctinomus nasutus* Tomes, Proc. Zool. Soc. London, pp. 68–69, 1861. (Not of Spix, 1823).

1878. *Nyctinomus brasiliensis* Dobson, Catal. Chiropt. Brit. Mus., pp. 437–439 (part).

1911. *Nyctinomus brasiliensis musculus* G. M. Allen, Bull. Mus. Comp. Zoöl., vol. 59, p. 244, July, 1911.

1918. *Nyctinomus murinus* ANTHONY, Mem. Amer. Mus. Nat. Hist., new ser., vol. 2, pt. 2, pp. 363–364, October 12, 1918.

Type locality.—Jamaica. Type specimen in the British Museum.

Geographic distribution.—Jamaica.

Diagnosis.—Size not so large as in the Bahaman animal; forearm, 40.0–42.5 mm.; tibia, 11.0–12.0 mm.; length of skull, 16.0–16.6 mm.; the color is a reddish chocolate brown. Distinguished from *T. muscula* and *T. constanzae* by its smaller ear, and from *T. bahamensis* by its shorter tibia as well as shorter ear.

Measurements.—For detailed measurements see tables, pages 20 and 26.

Specimens examined.—Sixteen (including 10 alcoholics), all from the island of Jamaica.

TADARIDA CONSTANZAE, new species

Type.—Adult male (in alcohol), No. 217205, U.S.N.M., collected at Constanza, Dominican Republic, September 26, 1916, by Dr. W. L. Abbott.

Geographic distribution.—Haiti and the Dominican Republic.

Diagnosis.—Next smaller in size to *T. bahamensis* of the West Indian group. For measurement see pages 21 and 26.

Measurements.—Type: Head and body, 54.2 mm.; tail, 32.2; tibia, 11.4; foot, 8.6; forearm, 41.0; third metacarpal, 42.6; fifth metacarpal, 24.2; ear from meatus, 17.2; ear from crown, 12.4; ear width, 15.2; total length of skull, 16.5; zygomatic breath, 8.8; interorbital breadth, 3.8; occipital depth, 5.8; breadth of braincase, 7.8; basal length, 13.8; maxillary tooth row, 5.6; breadth at m^2, 6.4; breadth at canines, 3.8; length of mandible, 11.4; mandibular tooth row, 6.2.

Specimens examined.—Sixty-nine from the following localities: **Haiti**: Bombardopolis, 1 skin, 1 alcoholic; St. Michel, 2 alcoholics. **Dominican Republic**: Constanza, 1 skin and 64 alcoholics.

Remarks.—This species is separable from the Bahaman form by its shorter tibia, slightly smaller skull, and darker color; from the Cuban form by its longer forearm; and from the Jamaican form by its larger ear as well as its slightly longer tibia.

TADARIDA ANTILLULARUM (Miller)

1902. *Nyctinomus antillularum* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 398, September 3, 1902.

1911. *Nyctinomus brasiliensis antillularum* G. M. ALLEN, Bull. Mus. Comp. Zoöl., vol. 54, p. 245, July, 1911.

1924. *Tadarida antillularum* MILLER, N. Amer. Recent Mamm. 1923, Bull. U. S. Nat. Mus. 128, p. 85, April 29, 1924.

Type-locality.—Roseau, Dominica, W. I. Type-specimen in United States National Museum.

Geographic distribution.—The islands of Dominica, St. Lucia, Guadeloupe, Montserrat, Antigua, Barbuda, St. Kitts, and Porto Rico.

Diagnosis.—Size small for the genus, forearm 36.6 to 41.4 mm., usually less than 40.0 mm.; length of tibia, 10.0 to 12.4 mm., usually less than 12.0 mm.; length of skull, 14.6–16.5 mm., usually 16.0 mm. or less. There are two color phases, mummy brown and russet. Ear falling short of the end of muzzle when laid forward.

Measurements.—For detailed measurements see tables, pages 21 and 26.

Specimens.—One hundred eighty-four from the following islands: Dominica, 34 alcoholics, 2 skins; St. Lucia, 11 alcoholics; Guadeloupe, 18 alcoholics; Montserrat, 2 alcoholics; Antigua, 21 alcoholics; Barbuda, 11 alcoholics; St. Kitts, 8 alcoholics, 2 skins; Porto Rico, 42 alcoholics, 3 skins U.S.N.M., 30 alcoholics A. M. N. H.

MACROTIS GROUP

The skulls in the members of the *macrotis* group are characterized by the long narrow rostrum, which is scarcely wider anteriorly than at the point of the least interorbital breadth; rather well developed sagittal crest; palate sometimes without an anterior emargination (*macrotis*) or with a very narrow one (*laticaudata*, *yucatanica*, *europs*, *femorosacca*); upper incisors set closely at their base, nearly touching, and extending in a parallel position downward; lower incisors four.

At the angle of the tibia and femur there is a conspicuous fold of membrane which forms a pocket on the under side. With the exception of *Tadarida europs* and *T. yucatanica* the animals are larger than the members of the *brasiliensis* group. The spines on the nasal border are sometimes continued downward as two lines between the nasal apertures converging in the middle until they touch, though sometimes they form a single line; but always there are two distinct lines at the base. Tragus somewhat as in members of the *brasiliensis* group, but not squarely truncate, its upper posterior corner bearing a small projection. Antitragus higher than wide. The ears are large; they extend well beyond tip of muzzle when laid forward, and their inner margins are united for about 2 mm. at base.

The second phalanx of the fourth finger is short, 2.0–4.4 mm. in all the specimens measured, and of equal length with the first phalanx, except in *T. europs*, where it is slightly longer than the first. When compared with the length of the forearm it is found to range from 3.5 per cent in *T. macrotis* to 9.5 per cent in *T. europs*.

TADARIDA AURISPINOSA (Peale)

1848. *Dysopes aurispinosus* PEALE, U. S. Expl. Exp., vol. 8, Mammalogy and Ornithology, p. 21. (Ed. 1.)

1858. *Molossus aurispinosus* CASSIN, U. S. Expl. Exp., vol. 8, Mammalogy and Ornithology, pp. 5–7. (Ed. 2.)

1902. *Nyctinomops aurispinosus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 15, p. 393, May, 1902.
1909. *Dysopes aurispinosus* LYON and OSGOOD, Catal. Type-Spec. Bull. U. S. Nat. Mus. 62, p. 279, January 28, 1909.

Type locality.—The type and only specimen known was taken "on board the U. S. S. *Peacock* off the coast of Brazil. On the 18th of November, when the ship was about 100 miles from land, south of Cape St. Roque." Type specimen in United States National Museum.

Diagnosis.—This bat is intermediate in size between *T. laticaudata* and *T. macrotis*, its nearest relatives. The tibia is 15.5 mm. and the forearm is 50.0 mm., while in *T. laticaudata*, the tibia is 13.2–14.6 and the forearm 46.0–48.6. In *T. macrotis* the tibia is 16.4–17.8 and the forearm 58.2–63.8.

Measurements.—For detailed measurements see table, page 22.

Specimens examined.—One, the type.

Remarks.—This bat is nearer to *T. laticaudata* than to *T. macrotis*; in fact it is my opinion that it is the same as the first-named species; but until specimens of *T. laticaudata* are known with a forearm reaching 50.0 mm. and a tibia as long as 15.5 mm., one can not positively say that it is.

It was originally a dry skin, but was placed in alcohol November 27, 1899, after relaxing in water to bring out the characters of the ears and membranes. Mr. Gerrit S. Miller, jr., then made a note of the color on the back of the label: "Belly wood brown; back between wood brown and russet." There is no skull.

TADARIDA LATICAUDATA (E. Geoffroy)

1805. *Molossus laticaudatus* GEOFFROY, Ann. Mus. Paris, vol. 6, p. 156.
1876. *Nyctinomus gracilis* DOBSON, Proc. Zool. Soc. London, p. 731, November 7, 1876 (part).
1878. *Nyctinomus gracilis* DOBSON, Catal. Chirop. Brit. Mus., pp. 436–437,(part).
1902. *Nyctinomops laticaudatus* MILLER, Proc. Acad. Nat. Sci. Phila., p. 393, May, 1902.

Type locality.—Paraguay. Geoffrey in his description of the species bases his name on Azara's description of bat No. 8 from Paraguay.

Geographic distribution.—Brazil and Paraguay.

Diagnosis.—Upper parts vandyke brown (Ridgway 1912), under parts paler, the hairs tipped with pale buff. One skin from Brazil is lighter in color, more of a reddish brown, but this skin is immature. Forearm, 45.6–48.6 mm.; total length of skull, 18.5–19.5 mm. This species is intermediate in size between *T. europs* and *T. macrotis*.

Measurements.—For detailed measurements see tables, pages 22 and 27.

Specimens examined.—Thirty-eight from the following localities: **Brazil**: Piracicaba, 1 skin; St. Catherine, 2 skins. **Paraguay**: Asuncion, 9 alcoholics, 5 skins; Sapucay, 10 alcoholics and 11 skins.

Remarks.—This bat bears a close relationship to *T. aurispinosa* the type and only known specimen of which has no skull. However, *T. aurispinosa* has a longer tibia and forearm, 15.5 mm. and 50.0 mm. as against a shorter tibia and forearm, 13.2–14.6 mm. and 45.6–48.6 mm. in *T. laticaudata*, which leaves some ground, though slight, for the separation of the two animals.

TADARIDA FEMOROSACCA (Merriam)

1889. *Nyctinomus femorosaccus* MERRIAM, North Amer. Fauna, No. 2, p. 23, October 30, 1899.

1902. *Nyctinomops femorosaccus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 393, September 3, 1902.

1923. *Tadarida femorosacca* MILLER, List North Amer. Recent Mamm. 1923, Bull. U. S. Nat. Mus. 128, p. 86, April 29, 1924.

Type locality.—Agua Caliente, Sonoma County, California. Type specimen in United States National Museum.

Geographic distribution.—Arizona, California, Lower California, and Jalisco, Mexico.

Diagnosis.—Like *T. laticaudata* but occipital depth of skull slightly less, 6.0–6.4 mm. as against 6.5–7.0 mm., and color of only skin examined, which is immature, darker, and less red than in South American specimens of similar age.

Measurements.—For detailed measurements see tables, pages 22 and 27.

Specimens examined.—Nine specimens examined from the following localities: **Arizona**: Fort Huachuca, 1 alcoholic, Coyote Mountains, 1 skin. **California**: Agua Caliente (type), 1 alcoholic; Colorado River mouth, 1 alcoholic. **Lower California**: Santa Anita, 1 alcoholic; San Pedro Mountains, 1 alcoholic. **Jalisco**: Zacoalco, 3 alcoholics.

Remarks.—The skins of *T. laticaudata* are near vandyke brown (Ridgway 1912), except one immature skin which is lighter in color than the adults, but distinctly different in color from the young *T. femorosacca.*

This form is so like *T. laticaudata* that if the form had not already been named there would be no very good reason for separating it.

The three specimens from Jalisco extend the known range of *Tadarida femorosacca* into central western Mexico. These specimens have been in the collection since 1892, but had never previously been separated from some specimens of *T. mexicana* collected at the same locality. Compared with specimens taken farther north they have a slightly longer ear, 22.2–22.8 mm. as against 18.6–21.5 mm. in five specimens from the United States and Lower California. The skulls have a rather better developed sagittal crest and the width at the base of the canines is greater, but these differences are slight and of no great importance in so small a series.

All specimens examined were alcoholics except one skin from Coyote Mountains, Arizona, which, as mentioned above, is immature, and indistinguishable in point of color from specimen of *T. mexicana*.

TADARIDA EUROPS (H. Allen)

1889. *Nyctinomus europs* H. Allen, Proc. Amer. Philos. Soc., vol. 26, pp. 558–561, October 4, 1889.

1904. *Nyctinomops europs* Trouessart, Catal. Mamm. viv. foss. suppl., p. 103.

Type locality.—Brazil, no exact locality given. Lectotype in United States National Museum.

Type specimen.—Harrison Allen based his description on 20 adult alcoholic specimens from Brazil, without exact locality. Ten of these specimens are in the United States National Museum collection. No. 101498, adult female, is therefore chosen as the lectotype.

Geographic distribution.—Brazil and Venezuela.

Diagnosis.—The nearest relative of *T. europs* is *T. yucatanica* from Yucatan, but *T. europs* is slightly the smaller of the two. The fur on the back of *T. europs* is dark (auburn), instead of vandyke brown (Ridgway 1912) as in *T. yucatanica*. However, the most noticeable external character of this bat is the peculiar manner of the growth of the fur on the back, where below the arm it does not extend on to the wing membrane, as it does in other members of the American forms of the genus *Tadarida;* instead, immediately below the humerus there is an abrupt inward narrowing of the fur area into a kind of slender pannel extending down to the base of the tail. This leaves an unusual bare spot on both sides of the back. This character will distinguish this species externally from any other American form of the genus.

Measurements.—For detailed measurements see tables, pages 22 and 27.

Specimens examined.—One hundred sixty-seven from the following localities: **Brazil**: no exact locality, 10 alcoholics. **Venezuela** (all specimens from Venezuela are American Museum specimens): Casiquiare Canal, Buena Vista, 7 skins, 1 alcoholic; Casiquiare Canal, Amapure, 25 skins, 20 alcoholics; Libreto, 15 skins; Paripari, 35 skins, Ocamo River, 54 skins.

Remarks.—When work began on this paper only 10 specimens of *T. europs* were available for study; however, since that time I have been able to see and examine the splendid collection of 157 specimens secured recently in Venezuela by G. H. H. Tate, of the American Museum of Natural History, New York. Mr. Tate explains in his field catalogue that these bats were collected in splits in the granite rocks along the edge of the Orinoco and Casiquiare Canal in the Province of Amazonas. Collected with bat net spread over crevices in rocks. Very numerous at dusk.

Tadarida europs departs farther from the standards for the *macrotis* group than any other species in the group. The manner of the growth

of the fur on the back, as described above, is different from that in any other American *Tadarida*. The second phalanx of the fourth finger is longer than the first phalanx, while in all other members of this group it is shorter.

TADARIDA YUCATANICA (Miller)

1876. *Nyctinomus gracilis* Dobson, Proc. Zool. Soc. London, p. 731, November 7 (part).
1902. *Nyctinomops yucatanica* Miller, Proc. Acad. Nat. Sci, Philadelphia, p. 393, September 3, 1902.
1912. *Nyctinomus yucatanicus* Miller, List N. Amer. Land Mamm. 1911, Bull. U. S. Nat. Mus. 79, p. 70, December 31, 1912.
1923. *Tadarida yucatanica* Miller, List North Amer. Recent Mamm. 1923, Bull. U. S. Nat. Mus. 128, p. 87, April 29, 1924.

Type locality.—Chichen Itza, Yucatan. Type-specimen in United States National Museum.

Geographic distribution.—Yucatan and Guatemala.

Diagnosis.—This species is nearest the Brazilian *Tadarida europs*, but it has a larger skull, total length 17.6–18.2 mm. as against 16.5–17.0 mm., and a longer tibia 12.6–13.8 mm. as against 11.2–12.0 mm. The palatial emargination is present, but very small.

Measurements.—For detailed measurements see tables, page 22 and 27.

Specimens examined.—One hundred twenty-four specimens were examined from the following localities: Chichen Itza, Yucatan, 12 skins, including the type; Flores, Peten, Guatemala, 29 skins, 52 alcoholics, and 31 skeletons without skins.

Remarks.—The specimens from Guatemala recorded by Dobson under the name *Nyctinomus gracilis* (1876)[7] undoubtedly pertain to this form. This bat is not very different in size from members of the *brasiliensis* group, but its deep reddish brown color is diagnostic.

TADARIDA MACROTIS (Gray)

1839. *Nyctinomus macrotis* Gray, Ann. Nat. Hist., vol. 4, pp. 5–6, September, 1839. (Cuba.)
1843. *Dysopes auritus* Wagner, Wiegm. Archiv., vol. 1., p. 368. (Cuyaba, Brazil.)
1876. *Nyctinomus megalotis* Dobson, Proc. Zool. Soc., London, pp. 728–729, November 7, 1876. (Surinam.)
1878. *Nyctinomus megalotis* Dobson, Catal. Chiroptera Brit. Mus., pp. 434–435.
1878. *Nyctinomus magrotis* Dobson, Catal. Chiroptera Brit. Mus., pp. 435–436.
1891. *Nyctinomus depressus* Ward, Amer. Nat., vol. 25, pp. 747–750, August, 1891. (Federal District, Mexico.)
1894. *Nyctinomus macrotis nevadensis* H. Allen, Monogr. Bats. N. Amer. (1893), p. 171, March 17, 1894. (California.)
1900. *Promops affinis* J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 13, pp. 91–92. December, 1900. (Colombia.)

[7] Proc. Zool. Soc. London, p. 731, 1876

1902. *Nyctinomops depressus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 393, September 12, 1902.
1902. *Nyctinomops macrotis* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 393, September 12, 1902.
1902. *Nyctinomops affinis* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 393, September 12, 1920.
1902. *Nyctinomus nevadensis* MILLER, Proc. Biol. Soc. Washington, vol. 15, p. 250, December 16, 1902.
1914. *Nyctinomus aequatorialis* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 33, p. 386, July 9, 1914. (Ecuador.)
1923. *Tadarida depressa* MILLER, List N. Amer. Recent Mamm. 1923, Bull. U. S. Nat. Mus., 128, p. 86, April 29, 1924.
1924. *Tadarida nevadensis* MILLER, N. Amer. Recent Mamm. 1923, Bull. U. S. Nat. Mus., 128, p. 87, April 29, 1924.
1924. *Tadarida macrotis* MILLER, N. Amer. Recent Mamm. 1923, Bull. U. S. Nat. Mus., 128, April 29, 1924.

Type locality.—Cuba. Collected by W. S. MacLeay in the interior of the Island of Cuba, where it was found in a hollow tree. Type specimen presumably in the British Museum.

Geographic distribution.—Brazil, Ecuador, Colombia, Cuba, Jamaica, Mexico, Arizona, California, and Iowa.

Diagnosis.—Size largest of the genus in the Western Hemisphere. Greatest length of skull, 22.2–24.0 mm.; maxillary tooth row, 8.2–9.5 mm.; forearm, 58.2–63.8 mm.; tibia 16.4–18.0 mm. The larger size makes it at once separable from any other American form of the genus.

Measurements.—For detailed measurements see tables, pages 23 and 27.

Specimens examined.—Fifty, from the following localities: **Brazil**: Ypiranga, 1 skin. **Ecuador**: Manvi Chone, 1 skin type of *N. aequatorialis*. **Colombia**: Tagauga, 1 skin type of *Promops affinis*. **Cuba**: 2 alcoholics. **Jamaica**: 30 alcoholics. **Dominican Republic**: 7 alcoholics. **Lower California**: 4 alcoholics. **Arizona**: 1 skin. **California**: no exact locality, 1 alcoholic. **Nevada**: 1 alcoholic. **Iowa**: 1 skin.

Remarks.—Because of the small number of specimens from the mainland, it has been very difficult to come to a conclusion on the status of the several described forms of this large *Tadarida*. A considerable number of specimens have been examined from the West Indies, but the larger part of them were immature. Only three skins have been obtainable from South America and with two of these, the types of *N. aequatorialis* and *Promops affinis* it has been impossible to take measurements of the tibiae, while it also appears that the forearm of *N. aequatorialis* has been broken off at the elbow, so that the forearm measurement may not be truly representative. I am unable to find any characters of differentiation in the skulls.

Dobson in his Catalogue of the Chiroptera in the British Museum, 1878, lists specimens of *N. macrotis* from Cuba, Brazil, and Paraguay. Two years previous, 1876, in Proceedings Zoological Society of London, he describes a new form from Surinam, *N. megalotis*, basing

his separation from *M. macrotis* on supposed larger size; but the measurements I have made of West Indian specimens alone show this difference in size to be of no value.

The next name applied to specimens from South America was *Promops affinis*, based on one adult and five young from Colombia. In J. A. Allen's description he has the following to say:

> The skull of *Promops affinis*, allowing for the immaturity of the specimens, closely resembles, in general form and character of the teeth, that of *P. depressus* (Ward) from Mexico. The two species are also practically of the same size and proportions, but in color *P. affinis* is much darker than *P. depressus*, and has the lower outer lobe of the ear much narrower, and the inflated upper internal border wider. They are obviously closely related forms, but their exact relationship can be determined only on comparison of a larger amount of more strictly comparable material.

Miller in 1902 [8] concluded that *Nyctinomus nevadensis* and *Nyctinomus depressus* were the same, and I have found nothing to upset his conclusion. I have examined the skin of the type of *Promops affinis*, which has no skull, also adult skins (one each) from Brazil, Ecuador, Arizona, Iowa, and an alcoholic (dried out) from Lower California. In all these specimens the color is argus brown (Ridgway, 1912), with the exception of the skin from Iowa, which is much darker than the others, near mummy brown (Ridgway, 1912). Five young specimens taken with the type of *Promops affinis* are also much darker in color than the adult skin. The fur in each skin is whitish at the base. I have not seen the type of *N. depressa*, but since the two adult skins from South American are so exactly like the adult skin from Arizona, there is no reason to suppose that the type of the Mexican *N. depressa* is different.

It may be necessary to recognize several local forms when adequate series of specimens are available for measurement of the forearm and tibia; but at present there is nothing to show that such forms exist.

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[8] Proc. Biol. Soc. Washington, vol. 15, p. 250, December 16, 1902.

External measurements of the brasiliensis group

TADARIDA BRASILIENSIS

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Brazil: Province of Parana	18550	♂	62.2	33.8	12.5	7.8	44.6	44.2	25.5	7.2	18.8	15.0	16.8
	18551	♀	59.8	35.0	12.2	8.6	45.2	46.6	27.6	8.0	17.2	13.4	17.0
	18552	♀	61.8	37.4	12.4	8.2	43.5	46.0	26.4	7.5	17.6	12.5	16.0
	18553	♀	61.2	35.6	12.2	8.2	45.2	45.6	26.8	7.2	18.6	14.0	15.6
	18554	♀	61.0	31.0	13.2	8.5	44.6	44.0	26.4	7.5	17.8	14.2	17.6
	18555	♀	61.6	33.6	13.2	8.8	45.6	45.6	27.2	7.6	18.2	13.2	17.4
Mendoza: Mendoza	236234	♂	58.8	36.0	13.6	8.6	44.4	44.2	26.0	7.6	17.4	13.2	17.0
Tucuman: Tucuman	236229	♀	63.6	34.0	11.4	8.4	42.4	43.0	25.6	7.4	18.5	12.6	16.1
Chili: Ramal de Mélipilla	142106	♀	58.5	32.5	13.2	8.2	45.6	46.0	27.0	7.0	17.2	12.2	16.8
Uruguay	102592	♂	58.5	31.2	12.5	8.4	44.5	45.2	27.2	6.6	18.2	12.2	17.0
	102593	♂	57.6	33.6	12.2	7.8	44.0	43.5	26.5	7.2	18.0	13.5	16.5
Paraguay: Villa Rica	105686	♀	61.5	36.8	13.2	8.6	45.0	45.8	28.0	7.2	16.6	13.2	16.6
	105687	♀	56.2	35.0	13.2	9.2	46.4	46.6	27.6	8.0	18.0	14.0	17.6
	105688	♂	59.4	34.2	13.2	8.5	43.5	43.2	25.5	7.2	17.4	12.4	16.6
Peru: Santa Ana	195150	♀	59.8	32.0	13.0	8.8	46.4	47.2	28.2	7.6	16.4	12.4	18.0
	195151	♀	58.2	35.2	13.0	7.5	45.6	46.4	27.4	7.5	17.4	12.4	17.4
	195152	♂	59.5	32.8	12.4	7.8	45.2	45.2	26.8	7.2	17.2	13.0	18.5
	195153	♂	58.5	36.0	12.2	8.5	45.4	46.5	27.2	7.8	17.4	13.5	17.4
	195155	♂	56.5	32.8	12.5	7.2	44.0	43.0	25.5	7.0	18.0	12.8	17.5
	195156	♀	60.2	35.6	12.8	7.5	45.5	44.4	26.6	7.0	18.2	14.2	18.0
	195157	♀	59.8	34.6	12.6	8.2	45.2	46.0	27.5	7.0	16.6	13.5	17.6
	195158	♀	58.4	33.0	12.2	8.2	45.6	44.8	27.5	6.6	16.2	13.0	17.2

TADARIDA INTERMEDIA

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Guatemala: Jacatlenango	78517	♂	58.4	33.8	12.6	------	44.0	44.0	26.4	6.8	16.6	10.5	15.5
	78518	♂	51.2	32.8	12.6	8.5	43.2	43.2	25.5	7.2	15.0	10.0	15.6
	78519	♀	53.8	34.6	13.2	8.6	44.8	45.8	26.2	7.4	16.2	11.8	13.5
Chiapas: Valley of Comitan	78486	♂	50.6	34.5	11.6	8.6	42.4	42.8	25.2	6.5	17.2	13.0	15.0
	78487	♂	54.6	32.8	13.2	9.0	43.8	44.2	26.6	7.6	18.2	14.0	18.6
	[1] 78488	♂	52.4	27.6	12.8	8.8	45.0	44.6	26.4	6.5	16.0	12.8	15.2
	78489	♂	54.5	32.6	12.5	8.6	42.6	43.8	25.5	7.6	18.0	13.8	16.4
	78490	♀	57.5	32.8	12.2	8.8	44.0	44.2	26.5	6.8	17.4	13.2	14.4
	78491	♀	54.8	31.2	12.0	8.5	43.2	44.6	26.2	7.0	16.5	12.5	15.5
	78492	♀	53.0	32.8	12.5	8.4	43.8	44.0	26.0	7.0	14.8	11.5	16.2
	78493	♀	56.0	31.8	12.4	8.5	45.4	46.8	27.0	7.2	17.2	12.2	15.6
	78494	♀	55.2	36.5	12.6	8.0	43.8	43.3	25.8	6.8	17.4	13.4	16.5
	78495	♀	55.8	37.8	12.0	8.4	43.2	43.8	26.4	6.5	16.5	12.6	14.8
	78496	♀	56.2	34.4	12.4	8.8	44.2	45.2	26.8	7.4	16.4	13.2	14.8

TADARIDA MEXICANA

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Puebla: Tehuacan	53776	♀	56.5	28.6	12.5	8.2	44.0	44.0	26.2	7.6	16.6	12.2	14.4
	53777	♀	56.2	36.6	12.5	8.2	43.4	44.5	26.2	7.4	18.4	12.8	17.0
	53778	♀	59.4	30.0	11.6	8.2	44.6	43.8	26.6	7.8	17.2	12.5	14.6
	53779	♀	54.6	32.4	11.4	7.8	44.4	44.8	26.8	7.6	17.4	12.2	15.6
	53785	♂	56.4	36.2	12.4	7.8	43.6	44.2	25.6	7.4	17.6	13.4	17.4
	53788	♀	59.6	34.2	12.5	7.2	43.6	43.8	26.2	7.8	18.2	13.6	16.6
	53789	♀	58.2	32.2	12.0	7.8	44.5	44.2	26.5	7.5	16.6	12.2	17.6
Vera Cruz: Maltrata	64340	♂	60.6	29.0	12.2	8.2	45.5	45.6	26.6	6.0	18.4	12.2	14.2
	64341	♀	62.6	35.8	12.5	8.8	46.6	47.0	26.0	7.4	19.5	13.0	18.6
	64342	♀	57.8	34.4	12.6	8.2	45.4	47.0	27.8	7.0	17.4	13.8	17.2
Morelos: Tetela del Volcan	53773	♂	56.5	40.0	12.5	8.2	45.6	46.5	26.8	6.8	17.2	13.8	17.5
Mexico District: Ixtapalapa	52430	♀	61.0	39.5	12.8	8.6	46.0	46.2	28.2	7.0	17.2	11.8	16.5
	52435	♀	60.8	37.2	11.8	8.4	42.4	43.6	25.8	7.0	17.6	12.4	16.8
	52436	♂	58.6	31.5	11.6	8.2	43.2	43.0	27.0	7.2	16.6	14.2	18.0
	52437	♂	59.4	34.0	13.0	8.0	44.6	45.6	26.8	6.8	16.5	13.5	17.0
	52439	♂	59.0	36.2	12.5	7.5	43.8	44.2	26.4	6.5	18.2	12.2	18.2
	52444	♂	60.4	39.6	12.6	8.6	45.2	46.0	27.2	7.2	18.8	13.8	19.0
	52445	♀	59.4	36.4	12.2	8.5	45.2	46.2	28.0	7.2	16.5	13.8	18.4
	52446	♀	61.2	37.0	12.2	8.2	44.2	45.5	26.8	6.6	18.0	13.8	18.8
	52447	♀	58.8	32.0	12.4	8.0	43.2	43.6	25.6	6.6	18.8	13.6	16.5
	52449	♀	59.8	32.4	11.6	7.4	42.2	42.5	25.6	6.6	18.0	14.0	16.8

[1] Type.

External measurements of the brasiliensis group—Continued

TADARIDA MEXICANA—Continued

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Michoacan: Patzcaro	52266	♂	58.2	29.0	11.8	9.5	43.5	43.0	25.8	7.2	17.4	13.8	15.8
	52267	♂	57.4	30.8	13.0	8.4	45.5	45.4	26.5	7.5	17.2	12.2	17.2
	52268	♂	57.6	36.6	12.4	8.2	45.2	45.5	27.5	8.0	18.0	13.6	17.0
	52269	♂	57.2	32.2	11.5	7.2	44.2	44.8	27.8	7.0	17.8	12.2	16.6
	52270	♂	58.2	33.6	12.0	8.8	43.8	44.6	26.8	7.4	19.8	14.4	18.8
	52289	♂	55.5	33.2	12.2	8.2	43.4	44.5	27.4	7.2	16.6	13.5	17.5
	52291	♂	57.8	33.5	12.0	8.4	43.8	45.6	26.8	7.2	17.8	13.6	17.5
	52292	♂	57.0	32.2	11.8	8.4	43.8	44.8	26.6	7.2	17.6	13.6	17.0
Guanajuato	62459	♂	55.6	32.8	11.8	8.8	43.6	43.2	26.5	7.0	17.8	13.5	17.5
	62460	♂	58.5	33.5	12.2	7.5	43.0	43.8	27.2	6.8	19.4	14.5	17.5
	62461	♀	55.5	31.5	12.2	7.8	42.6	43.6	26.6	7.4	17.8	13.8	18.6
	62465	♀	57.6	31.5	11.5	7.5	42.5	43.5	25.5	6.4	16.4	12.4	16.0
Colima: Colima	52067	♂	59.2	32.0	12.6	8.2	44.8	45.6	26.6	7.2	16.8	12.5	16.0
	52070	♀	58.4	30.5	11.8	7.8	42.0	43.8	26.0	6.4	17.8	13.8	16.0
Jalisco: Zapotlan	52118	♂	56.0	33.5	12.5	8.0	43.2	43.4	25.0	7.2	17.6	12.8	15.8
	52119	♀	55.5	32.4	12.8	8.2	44.4	45.5	27.2	7.5	16.6	13.2	16.5
	52120	♀	55.0	34.8	12.5	8.0	42.4	43.2	25.5	6.8	18.0	14.2	17.0
	52121	♂	54.6	30.8	12.0	8.0	44.0	44.2	26.4	6.6	17.2	13.0	16.6
San Luis Potosi: Ahualulco	52165	♂	58.5	32.5	11.8	4.5	44.0	44.8	26.8	7.0	17.5	11.8	16.0
	52166	♂	58.8	32.0	11.5	7.8	42.6	43.4	26.0	7.4	17.0	12.8	17.0
	52169	♂	56.0	36.0	13.0	8.8	45.5	45.2	26.4	7.0	17.6	13.5	17.8
	52170	♂	58.2	34.6	12.2	8.6	43.2	43.4	26.0	7.4	17.5	12.2	17.2
Zacatecas:													
San Juan	92558	♀	58.2	33.6	11.8	8.5	42.6	44.0	26.0	6.5	18.8	12.4	17.6
Capistrano	92469	♀	59.5	30.0	12.0	7.8	42.2	42.4	25.0	7.5	17.4	13.8	16.2
	92489	♀	58.2	33.5	12.0	8.2	43.0	------	25.8	7.4	18.0	12.5	17.6
Durango: Durango	132499	♀	54.8	33.2	12.6	7.5	42.8	42.5	26.2	7.4	15.6	12.8	16.4
Sinaloa: Culiacan	96900	♂	52.6	32.2	12.0	7.8	42.0	42.8	25.6	7.0	17.8	13.2	16.6
Texas:													
Austin	123379	♂	52.0	33.5	12.2	8.2	44.4	45.0	27.5	7.2	17.6	13.2	16.8
	123380	♀	53.4	35.0	12.5	8.6	43.6	44.6	25.4	7.6	18.0	13.2	17.4
Uvalde	235266	♂	58.4	33.2	12.2	8.5	43.2	43.8	26.6	7.6	17.5	13.4	17.2
	235268	♀	57.2	34.0	12.4	8.5	44.5	45.0	26.8	6.4	16.8	12.8	16.6
	235269	♂	55.6	33.4	11.6	9.0	44.2	44.0	26.4	7.0	17.5	12.8	16.8
New Mexico:													
Carlsbad Cave	244435	♂	60.3	------	13.0	8.5	45.2	44.8	27.8	7.8	18.2	13.8	18.4
	244436	♂	58.0	34.2	12.5	8.8	44.6	44.2	27.0	7.6	17.5	13.6	17.4
	244437	♀	57.6	31.8	12.8	8.1	45.0	45.0	27.0	7.0	17.5	12.8	17.2
Arizona: Yuma	53071	♀	58.8	32.2	12.8	8.8	43.4	44.2	26.4	7.4	17.2	12.6	16.5
	99693	♂	59.4	33.0	12.2	8.6	43.2	43.4	26.6	7.0	18.5	13.6	16.6
Utah: Jensen	239522	♀	59.5	32.2	12.0	8.2	42.8	44.5	25.8	7.4	18.5	13..	17.0
California:													
Bear Valley	65382	♂	61.0	33.5	13.0	8.2	43.2	44.8	26.4	7.6	19.0	14.4	16.2
	65384	♂	61.0	29.6	12.8	8.2	43.6	44.2	25.6	7.8	18.5	13.2	17.8
	65385	♂	59.5	35.6	12.8	8.5	45.0	45.6	26.8	7.8	18.0	15.2	16.8
Chinese Camp	65380	♂	59.8	36.8	13.0	8.6	46.0	45.5	27.0	6.8	18.0	13.6	17.4
Tuolumne County	65381	♂	58.4	32.8	12.2	8.6	44.2	43.6	26.2	7.2	18.8	14.2	17.5
Alhambra	61381	♂	63.4	32.6	13.0	8.8	44.2	43.4	25.8	7.6	18.0	13.2	16.0
	61382	♂	63.2	31.2	12.5	8.6	43.2	44.0	26.2	8.0	17.6	13.2	15.8
	61383	♂	58.4	33.2	11.4	8.2	40.4	41.8	25.6	6.6	16.8	13.5	14.8
	61384	♀	60.8	31.8	11.8	8.8	41.6	42.8	25.2	7.2	17.2	13.2	17.5
San Jose	55575	♂	60.6	33.2	12.2	8.4	43.4	43.5	26.2	6.8	18.8	14.5	16.6
	55576	♂	59.5	33.6	12.6	8.2	44.0	44.4	26.8	7.2	17.8	13.6	17.8
	55577	♂	60.6	33.5	12.4	9.0	43.8	44.2	26.0	7.2	18.2	13.4	16.2
	55578	♀	55.8	32.0	11.8	8.2	42.2	43.0	25.4	6.8	16.5	12.8	16.5
Cloverdale	16518	♂	55.8	33.5	12.5	8.4	43.0	45.0	26.2	7.0	16.8	12.6	15.6
	16519	♂	60.6	33.8	11.8	8.0	42.2	44.8	26.2	6.5	16.2	11.6	16.8
	16520	♀	54.8	33.2	11.5	8.2	42.5	44.2	26.4	6.6	16.8	11.8	15.2
	16521	♂	60.2	31.8	12.4	8.0	42.2	43.5	25.4	6.8	17.2	12.5	16.5
Colusa	133098	♀	57.8	33.2	12.5	8.4	45.0	45.2	27.2	7.0	18.0	12.8	16.0
	133099	♀	55.0	31.8	12.0	8.4	43.0	44.2	26.0	7.2	17.5	12.8	15.6
	133100	♀	59.0	35.6	12.8	8.0	42.8	43.0	25.8	7.2	18.5	13.4	17.5
	133258	♀	58.0	33.5	12.2	8.0	44.2	45.2	27.0	7.8	18.5	13.0	18.2

External measurements of the brasiliensis group—Continued

TADARIDA CYNOCEPHALA

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Louisiana: Houma	52832	♂	62.2	26.8	11.2	7.8	42.8	42.8	25.8	7.4	18.6	15.0	16.8
	52836	♂	57.4	32.0	11.5	9.2	42.8	43.2	25.5	8.0	18.4	13.6	17.8
	52841	♂	61.6	37.0	11.5	8.8	43.0	43.8	26.6	8.0	18.0	13.4	17.2
	52845	♂	64.8	31.8	12.2	8.4	45.5	45.4	27.4	7.5	19.2	15.2	18.2
	52847	♂	61.5	31.6	11.2	8.4	43.6	45.2	27.0	8.4	19.8	14.2	17.8
	52873	♀	64.0	32.2	11.5	8.4	44.2	44.5	27.2	7.2	19.0	13.0	16.0
	52875	♀	63.2	29.2	12.0	9.2	43.8	44.2	26.5	7.4	18.6	12.5	18.0
Alabama: Greensboro	23424	♀	59.0	30.8	11.2	8.0	42.4	43.2	26.0	7.6	17.8	12.2	16.6
	23425	♀	56.0	32.8	11.5	7.8	43.2	44.5	27.2	7.2	19.4	12.8	17.6
	23428	♀	58.8	32.4	11.6	8.2	44.0	44.8	27.4	7.0	17.6	11.6	17.2
	23430	♀	62.0	31.4	11.2	8.6	42.2	44.2	26.6	7.2	18.8	12.6	16.4
	23431	♀	55.2	32.8	11.0	8.2	42.4	42.2	25.6	7.0	17.5	12.2	16.0
Florida: Gainesville	243241	♂	65.2	27.5	11.2	7.8	41.5	42.5	25.5	7.5	18.4	13.4	17.0
	243248	♀	59.8	30.8	11.2	7.4	42.2	44.5	25.5	7.2	18.0	14.2	16.6
	243249	♂	63.6	31.2	11.4	8.2	42.5	44.4	26.0	8.2	19.0	13.6	18.6
	243250	♀	60.6	30.4	11.5	8.0	43.4	44.4	26.2	6.8	17.5	13.2	16.8
	243252	♀	63.4	31.2	11.6	8.0	42.2	42.8	25.6	7.4	18.5	13.5	17.5
	243256	♀	57.5	31.6	11.4	8.6	43.0	44.0	26.5	6.8	18.2	13.8	17.0
	243257	♂	62.8	31.2	11.2	7.6	43.0	43.0	26.4	7.4	17.6	13.5	16.2
	243258	♀	61.0	33.2	11.6	8.2	42.5	43.8	25.8	7.2	18.0	14.0	17.2
	243259	♀	60.0	35.2	11.8	7.8	44.5	44.2	26.0	7.2	18.0	13.5	17.0
	243260	♀	60.5	31.0	11.8	8.2	41.5	43.2	25.6	7.4	17.4	13.8	17.5

TADARIDA BAHAMENSIS

Bahama Islands	217290	♀	------	31.5	12.2	8.2	42.4	43.8	25.2	6.2	17.4	13.2	15.5
	217293	♀	55.6	33.4	12.5	8.8	42.5	43.0	26.2	6.5	17.0	13.5	16.2
	217294	♀	58.5	30.8	12.2	8.8	41.2	42.2	24.6	7.2	15.5	11.5	15.8
	217295	♀	57.0	30.5	12.4	8.2	42.0	43.4	25.2	6.5	16.0	11.2	15.6
	217296	♀	53.6	31.5	13.2	8.8	41.2	41.4	24.5	7.2	16.8	11.5	14.5
	217297	♀	56.6	33.0	12.6	8.0	42.0	42.2	25.0	6.2	15.8	13.0	16.2
	217300	♀	55.5	28.8	12.0	8.4	40.0	40.0	22.6	6.5	17.2	12.6	14.8
	217276	♀	61.0	31.8	12.4	8.2	43.2	43.5	25.0	6.6	16.6	13.6	16.6
	217285	♀	59.0	33.5	12.5	8.2	41.6	42.5	25.4	6.6	17.2	12.2	15.2
	217287	♀	57.2	33.4	12.8	8.2	42.2	41.8	24.0	7.2	15.8	12.6	15.2

TADARIDA MUSCULA

Cuba	103771	♀	------	------	------	------	38.2	------	------	------	16.2	------	------
	103773	♂	------	------	------	------	39.5	------	------	------	16.5	------	------
	103774	♂	52.5	32.5	11.0	7.6	39.8	39.8	22.6	6.2	17.0	11.6	16.0
	175745	♀	------	------	------	------	40.5	------	------	------	17.0	------	------
	175746	♀	------	------	------	------	40.0	------	------	------	16.2	------	------
	216691	♂	50.5	29.8	11.2	8.0	40.2	41.0	24.6	6.5	16.8	12.2	14.5
	216692	♀	------	------	------	------	39.5	------	------	------	16.8	------	------
	218015	♀	51.8	30.5	11.0	8.0	39.5	40.2	24.0	6.2	16.2	11.4	13.5
	218016	♀	52.5	34.0	12.0	8.0	39.8	41.5	24.6	6.2	16.5	11.6	14.5
	218017	----	58.5	36.0	12.0	8.2	41.0	42.2	25.0	6.2	17.0	12.0	16.0
	123181	♀	48.5	30.0	11.0	7.8	38.8	39.2	22.0	6.5	16.8	12.0	14.8
	123182	♀	54.5	33.6	12.0	8.5	40.0	40.5	24.2	6.0	16.2	12.2	16.2
	123183	♀	53.0	30.5	11.2	8.5	40.0	41.2	24.0	6.0	16.2	12.0	13.2
	123184	♀	53.5	31.0	12.2	8.0	41.2	41.4	24.6	6.5	16.8	11.0	15.0

TADARIDA MURINA

West Indies: Jamaica	103921	♂	50.8	33.0	11.8	8.0	41.4	42.0	24.8	6.6	15.5	11.0	15.2
	122643	♂	56.0	33.0	12.0	8.2	42.6	42.2	24.6	6.6	16.2	11.0	15.0
	122642	♂	55.5	32.5	12.0	8.0	41.0	41.2	24.4	6.8	15.8	10.6	14.6
	122644	♂	53.8	31.0	11.0	7.6	40.4	41.0	24.2	6.6	15.8	12.5	14.6
	122645	♂	56.6	34.2	11.8	7.6	41.0	42.0	24.4	6.5	16.2	10.6	15.0
	122646	♂	52.5	30.5	11.2	7.2	40.6	40.8	23.8	6.2	16.2	12.5	15.6
	122647	♂	51.4	30.5	11.4	8.2	40.0	40.6	24.0	6.0	16.2	12.0	14.4
	122648	♂	55.5	32.5	11.4	8.2	40.6	41.8	24.2	6.8	15.8	13.0	15.0
	122649	♀	53.0	31.8	11.8	7.8	40.2	40.8	23.2	6.0	15.8	10.8	15.0
	122650	♀	57.0	32.8	11.2	8.5	41.8	41.8	24.5	6.2	15.0	11.6	15.2

External measurements of the brasiliensis group—Continued

TADARIDA CONSTANZAE

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Haiti	240925	♂	56.0	30.5	12.0	8.0	41.8	43.8	------	5.0	15.5	11.5	12.5
	240924	♂	55.0	30.5	11.5	8.2	42.0	42.5	24.0	5.5	17.0	12.0	12.6
Santo Domingo: Constanza	217150	♀	57.5	28.5	12.0	7.8	43.0	43.0	25.4	6.6	14.8	12.0	13.0
	217168	♀	54.4	34.2	11.8	8.0	41.0	42.0	24.2	6.5	17.5	12.5	14.8
	217169	♂	55.5	------	11.5	7.6	41.0	42.0	24.4	6.6	16.0	12.0	16.0
	217173	♀	57.4	31.8	12.2	8.2	42.0	43.0	25.8	6.4	16.0	13.4	15.8
	217183	♂	55.4	33.6	12.0	8.6	42.2	42.6	24.5	6.6	17.0	12.4	16.4
	217182	♂	53.0	28.4	12.0	8.2	42.2	41.5	24.2	6.6	16.6	12.0	15.4
	217184	♂	57.2	31.0	12.2	8.6	41.4	42.4	24.2	6.6	16.0	11.4	15.2
	217194	♀	52.6	30.5	11.8	8.0	41.2	40.6	23.6	6.0	16.8	12.8	15.5
	217198	♂	52.8	29.8	12.2	8.2	------	41.6	24.6	6.0	17.2	12.5	16.4
	[1]217205	♂	54.2	32.2	11.4	8.6	41.0	42.6	24.2	6.2	17.2	12.4	15.2

TADARIDA ANTILLULARUM

Porto Rico: Hucares	86316	♂	51.5	31.0	12.0	8.0	39.6	40.0	23.5	7.4	14.0	11.0	15.0
	86317	----	52.6	31.0	12.0	7.4	39.9	41.5	24.5	7.2	17.0	12.0	15.2
	86318	♀	50.0	30.2	11.2	8.2	39.2	39.5	24.2	6.4	15.5	11.0	13.2
	86319	♀	50.5	30.6	11.0	8.0	39.2	38.8	23.0	7.2	15.5	11.6	13.5
	86320	♂	52.0	33.0	11.5	7.5	38.2	38.8	24.2	7.0	15.6	12.0	13.6
	104075	----	52.5	32.8	11.6	8.2	41.0	40.5	24.0	7.4	16.5	12.0	14.2
Adjuntas	86330	----	53.0	33.5	11.2	8.2	40.0	40.2	23.8	6.4	16.0	10.5	13.0
	86334	♂	50.0	32.5	12.0	8.2	40.0	40.8	23.5	6.2	15.8	10.5	13.2
West Indies: St. Kitts	86865	♀	54.5	29.5	11.4	7.8	39.5	40.5	24.2	6.4	14.6	10.6	14.0
	86866	♀	49.5	32.2	11.2	7.8	38.4	39.8	24.6	7.0	14.8	11.0	12.5
	86867	♂	52.5	32.2	12.2	7.6	39.0	39.2	24.0	6.5	16.0	11.2	14.0
	86868	♀	52.0	31.6	11.4	7.6	38.6	39.2	23.2	6.6	14.0	11.8	14.2
	10940	♀	55.5	------	12.0	7.6	39.6	41.0	24.5	7.0	15.4	11.6	14.5
Barbuda	123234	♀	51.2	28.2	11.4	7.8	39.4	40.0	24.5	6.8	14.0	11.5	12.2
	123235	♂	50.6	31.8	12.0	8.2	40.0	40.5	24.4	6.8	14.5	10.0	13.5
	123236	♀	53.6	32.5	12.0	8.6	40.5	40.8	24.8	6.5	14.4	11.2	14.0
	123237	♀	49.0	31.5	11.0	8.0	39.6	41.8	24.6	6.6	14.0	11.0	13.5
	123238	♀	51.8	32.4	12.2	8.0	39.0	41.6	25.0	7.0	15.5	10.6	13.5
	123240	♂	53.5	32.5	12.4	7.5	40.5	40.5	25.0	6.6	15.0	11.2	15.4
	123241	♀	49.4	------	11.8	7.4	37.6	38.2	23.4	6.4	14.8	10.4	13.5
	123242	♀	49.8	34.2	12.2	7.8	39.5	39.4	24.5	7.2	15.0	11.5	13.2
	123243	♀	51.0	33.2	12.0	8.4	40.2	40.8	25.4	7.0	14.6	9.8	14.6
British West Indies: Antigua	219311	♀	54.0	30.6	11.4	7.8	40.0	40.5	24.5	7.0	14.0	11.4	13.5
	219313	♀	56.5	33.5	12.4	9.0	41.2	42.0	26.0	6.6	15.6	12.2	14.6
	219314	♀	54.5	32.5	11.5	9.2	40.4	41.4	24.4	6.0	13.0	11.4	13.6
	219315	♀	56.5	33.8	12.5	7.8	40.5	42.6	25.5	6.8	13.5	12.0	14.5
	219316	♀	53.8	32.0	11.5	7.6	39.2	41.5	24.5	6.4	16.0	11.5	13.0
	219317	♀	56.6	29.5	12.2	8.4	41.4	42.0	25.8	7.4	13.5	11.2	15.0
	219318	♀	55.4	31.6	12.4	7.8	40.4	42.2	25.5	6.8	13.6	11.5	14.5
	219319	♀	56.2	33.0	12.2	8.0	40.5	41.6	25.0	6.5	14.6	11.4	14.8
	219320	♀	56.0	33.2	12.2	8.0	40.0	41.4	25.0	6.5	15.2	11.2	12.5
	219321	♀	55.4	30.2	11.6	7.6	39.4	41.5	24.5	6.4	15.2	11.4	14.8
	219322	♀	55.6	32.0	12.2	7.8	38.8	40.5	24.2	6.2	15.0	10.0	14.0
Montserrat	101580	♂	51.8	29.4	11.4	7.2	37.6	38.0	23.0	6.0	13.8	10.4	14.0
	143876	♀	49.2	30.5	11.0	7.6	37.8	37.6	22.5	6.2	14.6	10.4	14.2
Guadeloupe	113505	♀	54.0	31.0	11.8	8.0	38.2	39.5	23.5	7.0	16.5	11.0	14.0
	113506	♂	53.4	30.4	11.2	8.0	39.0	39.5	24.2	6.4	15.8	11.6	14.6
	113507	♂	51.8	31.5	11.2	8.2	38.8	38.5	23.0	6.0	16.5	10.2	13.5
	113508	♀	53.2	29.0	12.5	8.2	39.6	41.0	24.2	7.0	15.5	11.6	14.0
	113509	♂	55.0	32.8	11.0	8.6	39.6	39.6	23.6	6.6	16.0	12.5	15.5
Dominica	113640	♂	52.4	29.0	10.8	7.8	38.2	38.0	22.2	7.0	15.2	11.0	14.6
	113642	♀	46.6	28.2	11.0	7.6	37.2	37.6	21.8	6.2	16.0	9.0	12.2
	113643	♀	50.2	28.0	10.8	7.2	36.6	37.0	21.6	5.8	15.2	11.2	15.2
	113644	♀	50.0	31.2	11.6	8.2	37.6	38.8	23.4	6.2	14.5	11.4	14.0
	113646	♀	52.8	29.0	12.4	7.6	37.4	37.4	22.0	6.2	14.6	10.0	13.2
	[1]113188	♂	50.6	29.5	11.6	6.5	39.4	40.2	23.4	6.2	14.6	11.5	12.8
St. Lucia	110906	♀	52.5	32.4	11.5	7.8	37.8	38.2	22.8	5.5	15.4	11.6	14.0
	110907	♀	51.4	32.4	11.0	7.6	39.0	40.8	23.8	6.6	15.4	11.5	14.4
	110908	♀	52.8	31.5	11.6	7.8	39.6	40.5	24.0	7.0	16.0	11.4	14.0
	110909	♂	49.4	29.0	10.0	8.0	37.0	37.6	22.0	6.0	15.2	12.0	13.4
	110910	♂	51.5	31.0	10.8	8.6	38.5	39.5	23.5	6.5	15.0	11.8	14.4

[1] Type.

External measurements of the macrotis group

TADARIDA AURISPINOSA

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Brazil (100 miles off coast)	[1] 3726	♂	------	------	15.5	8.6	50.0	51.2	29.5	7.0	------	------	-----

TADARIDA LATICAUDATA

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Paraguay: Sapucay	114965	♂	62.8	45.0	14.2	9.0	46.5	45.2	27.4	7.2	21.2	16.4	18.8
	114966	♂	67.0	40.8	13.6	8.0	48.6	47.0	27.5	7.2	21.8	17.0	22.5
	114967	♂	67.2	42.2	14.0	9.2	46.2	45.2	26.5	7.2	21.6	16.2	22.0
	114968	♂	65.8	41.2	13.6	8.4	46.8	47.4	28.2	7.6	20.4	15.0	20.6
	114969	♂	67.8	43.4	14.2	9.8	48.2	48.0	28.8	7.2	20.8	14.5	20.2
	114970	♂	65.0	44.2	14.6	9.5	48.2	46.8	27.5	8.0	21.5	15.4	22.0
	114971	♂	63.2	39.8	13.4	8.8	46.2	45.5	27.2	7.0	19.4	14.4	20.2
	114972	♂	63.2	37.2	13.2	9.0	46.8	47.0	28.0	7.6	20.5	15.5	20.0
	114974	♀	65.0	41.2	14.2	8.4	47.2	47.6	28.4	7.5	21.0	16.6	21.2
	114976	♀	64.6	45.2	13.6	8.6	45.6	46.4	27.6	7.0	21.0	14.8	20.0

TADARIDA FEMOROSACCA

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Jalisco: Zacoalco	51520	♂	64.0	40.0	13.8	8.2	47.2	47.2	26.4	7.8	22.8	17.2	21.6
	51522	♂	60.2	43.0	14.2	8.6	49.2	50.0	27.8	7.0	22.2	15.6	21.5
Arizona: Fort Huachuca	51521	♂	------	44.0	13.2	8.0	------	47.2	26.5	7.2	22.2	16.5	19.5
	20922, 36038	♀	54.4	------	13.4	8.5	46.6	45.2	25.8	6.4	18.6	11.8	16.8
California: Colorado Desert	[1] 186447	♂	60.6	41.6	13.0	7.6	47.8	47.8	28.0	7.0	20.6	15.4	18.8
Lower California: Santa Anita	96486	♂	61.6	39.0	12.6	8.0	46.4	46.6	26.2	6.8	21.2	15.0	20.0
San Pedro Mts.	38919, 22458	♂	65.2	40.0	12.6	8.2	48.2	47.8	26.6	6.4	21.5	13.5	18.8
Mexico: Colorado R. Mth	11170	♂	------	36.4	12.2	8.2	45.5	44.8	26.2	7.2	------	------	-----

TADARIDA YUCATANICA

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Yucatan: Chichen Itza	108156	♂	54.0	41.8	13.8	8.8	43.2	45.2	25.2	7.8	------	------	-----
	108157	♂	58.0	37.0	13.5	7.8	43.2	44.4	25.0	6.6	------	------	-----
	108159	♀	55.2	33.5	12.6	7.8	41.8	42.4	23.6	6.8	------	------	-----
	108161	♀	60.4	------	12.2	8.2	42.6	42.0	23.8	6.4	------	------	-----
	108166	♀	58.4	39.0	13.6	8.4	43.5	43.6	24.4	6.5	------	------	-----
Guatemala: Peten	245219	♀	56.4	37.4	13.5	8.2	43.0	42.4	24.2	7.2	19.2	13.2	19.2
	245228	♂	63.5	38.8	11.8	7.5	44.2	44.4	24.8	7.4	19.5	15.2	19.6
	245245	♂	58.2	39.4	12.5	8.0	44.5	43.4	25.2	7.0	20.0	14.6	18.5
	245250	♂	62.8	39.2	11.5	8.2	44.4	43.8	24.8	7.4	20.6	15.6	19.8
	245265	♂	61.2	35.6	12.5	8.5	44.6	44.0	24.6	7.4	19.5	13.6	17.5

TADARIDA EUROPS

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Brazil	101492	♀	55.6	35.8	11.4	7.5	44.2	44.4	26.2	6.8	17.8	14.0	16.5
	101493	♀	56.8	37.5	11.5	7.4	43.0	43.2	26.4	7.4	17.4	13.2	16.5
	101495	♀	60.4	36.6	11.2	8.0	42.5	43.8	26.0	7.2	17.6	12.4	15.2
	101496	♀	57.8	39.6	12.0	8.6	45.2	45.2	27.5	7.8	18.0	11.6	15.0
	[2] 101498	♀	58.8	36.2	11.6	7.5	43.2	44.5	27.2	7.4	18.6	13.6	15.0
	101500	♀	57.8	37.6	11.2	8.4	43.6	42.8	26.6	7.4	19.5	14.8	17.4
	101502	♀	56.0	35.2	11.8	7.6	43.6	43.6	26.0	7.5	17.4	15.0	15.6
	101504	♀	56.2	35.8	11.5	7.4	42.6	42.6	25.8	7.4	19.6	12.0	16.4
	101505	♀	55.4	35.4	11.4	7.6	------	------	25.2	7.4	18.4	12.5	17.2
	101508	♀	56.4	37.6	11.4	7.6	42.8	42.2	25.8	7.0	18.0	12.2	17.4

[1] Type.
[2] Lectotype.

External measurements of the macrotis group—Continued

TADARIDA MACROTIS

Locality	No.	Sex	Head and body	Tail	Tibia	Foot	Forearm	Third metacarpal	Fifth metacarpal	Thumb	Ear from meatus	Ear from crown	Ear width
Jamaica	96192	♂	70.0	49.8	17.0	10.2	58.2	59.8	28.2	7.6	29.0	19.5	26.2
	91194	♂	74.5	48.0	17.2	11.0	60.0	58.4	29.0	8.2	27.4	18.2	25.0
	122655	♂	72.0	50.4	17.8	9.4	59.5	58.8	28.0	6.6	26.2	19.2	24.4
Dominican Republic	105696	♀	68.8	49.2	16.4	10.4	59.8	58.8	29.2	8.0	28.2	18.2	24.2
	105697	♀	75.8	53.6	17.6	9.8	61.5	60.0	28.4	7.5	26.8	18.6	24.4
	105699	♂	77.0	51.5	16.4	9.8	61.8	59.5	30.4	8.2	30.4	20.5	24.2
	105700	♂	73.5	51.5	16.6	9.4	61.8	60.0	29.4	8.5	27.8	19.8	26.6
	105701	♂	73.4	53.8	17.6	9.5	60.0	60.2	29.8	9.2	28.6	21.4	26.4
	105702	♂	71.6	50.5	17.2	9.2	60.0	59.4	29.8	8.0	27.5	17.5	25.8
	105703	♂	74.0	49.2	17.8	9.2	60.5	58.6	30.0	8.2	29.4	21.2	27.2
Cuba	252961	[3] ♂	71.5	47.0	16.8	10.0	59.6	58.6	30.0	7.8	26.0	20.5	25.0
	252962	[3] ♂	74.0	50.0	17.4	9.4	60.5	59.2	29.6	8.0	27.8	20.0	24.8
Mexico	[4] 516	---	79.0	52.0	18.0	13.0	60.0	58.7	29.0	------	------	------	------
Lower California: Santa Anita	96487	♂	74.4	51.4	16.4	10.4	62.6	61.0	31.0	7.8	27.6	17.6	23.5
	96488	♂	75.2	55.5	17.0	9.5	62.8	61.0	31.0	7.8	28.6	16.2	23.2
	96489	♂	74.0	51.8	17.8	9.4	60.6	61.2	31.0	7.6	28.0	17.8	24.2
	148549	♂	75.6	49.2	16.8	8.9	63.8	61.4	30.5	8.5	28.4	15.8	23.8
California	15178 / 36569	[3] ♀	------	48.2	18.2	9.4	58.0	56.6	29.4	7.2	22.2	------	------
Arizona: Chiricahua Mountains (A. M. N. H.)	8414 / 6740	[5] ♀	------	------	16.6	10.2	61.2	59.4	30.0	------	------	------	------
Iowa: Marshalltown (F. M.)	21819	[5] ♀	------	------	18.0	10.0	61.4	59.8	30.4	------	------	------	------
Brazil: Ypiranga	200994	[5] ♀	73.6	44.0	17.6	9.5	63.8	60.6	30.2	6.8	------	------	------
Surinam (B. M.)	[6]	♂	67.0	57.0	17.0	9.0	60.4	------	------	------	29.0	19.0	31.0
Ecuador: A. M. N. H.	[7] 34383	(5)	66.6	52.2	------	10.2	60.0	63.4	30.4	7.6	------	------	------
Colombia: A. M. N. H.	[8] 15109	[5] ♀	------	------	------	------	61.8	60.5	30.0	------	------	------	------

[3] Young.
[4] Type of *Nyctinomus depressus*, measurements taken from original description.
[5] Dry skin.
[6] Type of *Nyctinomus megalotis*, measurements taken by G. S. Miller, jr., 1904.
[7] Type of *Nyctinomus equatorialis*.
[8] Type of *Promops affinis*.

Cranial measurements of the brasiliensis group

TADARIDA BRASILIENSIS

Locality	No.	Sex	Total length	Zygomatic breadth	Interorbital breadth	Occipital depth	Breadth of braincase	Basal length	Maxillary toothrow	Breadth at M^2	Breadth at canines	Length of mandible	Mandibular toothrow
Costa Rica: San Jose	87552 / 13810	---	17.2	------	4.2	6.0	8.2	14.2	6.2	6.8	4.4	12.0	6.4
Brazil: Province of Parana	37872	♀	17.0	9.8	4.0	6.0	8.5	14.2	6.2	7.2	------	12.0	6.6
	37873	♀	17.4	10.2	4.2	6.2	8.5	14.5	6.4	7.0	------	12.5	6.8
	37874	---	17.2	------	4.0	5.8	8.0	14.6	6.0	7.2	4.4	12.2	6.5
Paraguay: Villa Rica	105617	♀	17.2	9.8	4.4	6.2	8.6	14.5	6.4	6.8	4.5	------	------
	105618	♂	17.5	10.2	4.2	6.4	8.6	15.0	6.6	7.2	4.5	12.5	6.6
Peru: Matchu Picchu	194440	♂	17.5	------	4.2	6.0	8.5	14.8	6.5	7.0	4.0	12.2	7.2
	194441	♂	18.0	10.2	4.2	6.2	8.8	14.8	6.5	7.0	4.2	13.0	7.0
Santa Ana	194443	---	17.6	9.6	4.4	6.0	8.6	14.6	6.4	6.8	4.5	12.6	6.8
	194444	♀	17.4	10.0	4.2	6.0	8.5	14.5	6.2	7.0	4.2	12.5	7.0
	194446	♀	17.5	9.5	4.0	6.0	8.2	14.8	6.5	7.0	4.0	12.8	7.0
	194448	♀	17.0	9.4	4.0	5.8	8.4	14.4	6.2	6.8	4.2	12.2	6.6
Lima Surca	155554	♂	16.5	9.0	3.8	6.2	8.0	13.8	6.2	6.8	3.8	11.5	6.6
Chile: Temuco	242899	♂	17.0	------	4.0	------	8.5	------	6.4	6.8	------	12.2	6.8
Ranal de Melipilla	142107	♂	17.6	9.8	4.2	6.0	8.6	14.8	6.5	7.2	4.0	12.8	7.0
Argentina: Tucuman	155555	♀	17.0	9.4	4.0	6.4	8.4	14.2	6.0	6.8	4.0	12.4	6.6
	155556	♀	17.0	------	4.0	6.0	8.2	14.2	6.2	6.6	3.8	12.0	6.5
	236354	♂	17.4	10.0	4.2	6.0	8.5	14.6	6.4	6.8	4.0	12.0	6.8
	236355	♀	17.2	9.8	4.2	6.2	8.6	14.8	6.4	7.0	4.0	12.4	6.8

Cranial measurements of the brasiliensis group—Continued

TADARIDA INTERMEDIA

Locality	No.	Sex	Total length	Zygomatic breadth	Interorbital breadth	Occipital depth	Breadth of braincase	Basal length	Maxillary toothrow	Breadth at M²	Breadth at canines	Length of mandible	Mandibular toothrow
Guatemala: Jacatlenango.	78517	♂	16.2	9.2	3.8	6.2	8.2	13.8	5.8	6.6	4.2	11.8	6.5
	78519	♀	16.2	9.2	4.0	5.8	7.8	13.5	5.8	6.4	3.8	11.8	6.2
Chiapas: Valley of Comitan.	78486	♂	15.8	------	3.8	5.6	7.6	13.2	5.6	6.2	3.8	10.8	6.0
	[1] 78488	♂	15.8	8.5	3.8	5.8	7.8	13.2	5.6	6.4	3.6	11.4	6.2
	78489	♂	16.0	------	4.2	6.0	8.2	13.5	5.8	6.5	3.6	11.2	6.2
	78490	♀	------	------	------	5.6	7.8	13.6	6.0	------	------	11.8	6.2
	78491	♀	15.5	9.2	4.0	5.5	7.8	13.0	5.5	6.4	4.0	11.4	6.0
	78492	♀	15.5	------	3.8	5.8	7.8	13.0	5.6	6.4	3.4	11.6	6.2
	78493	♀	------	9.2	4.2	6.0	8.2	13.8	6.0	6.4	4.0	11.8	6.4
	78494	♀	16.2	9.2	3.8	------	7.6	------	5.8	6.2	3.5	10.8	6.2
	78495	♀	------	8.6	4.2	------	7.8	------	6.0	6.4	3.8	11.4	6.5
	78496	♀	15.8	8.8	3.8	6.2	8.4	12.8	5.8	6.4	4.2	11.6	6.4

TADARIDA MEXICANA

Puebla: Tehuacan	53778	♀	16.8	9.4	3.8	5.8	8.2	14.2	6.2	6.6	3.8	12.0	6.5
	53780	♀	16.6	9.4	4.2	5.8	8.2	14.2	6.0	6.6	3.8	11.8	6.2
	53781	♂	16.8	9.6	4.4	6.2	8.2	14.4	6.2	6.6	4.0	12.0	6.6
	53782	♂	16.8	------	4.2	5.8	8.4	14.4	6.2	6.8	4.5	12.4	6.8
Michoacan: Patzcuaro	52267	♂	17.0	9.6	4.2	6.2	8.2	14.4	6.2	6.8	4.0	12.0	6.5
	52268	♂	17.4	9.4	3.8	5.8	8.2	14.8	6.6	6.8	4.2	12.2	6.5
	52270	♂	17.2	9.5	4.2	6.2	8.2	14.6	6.4	6.5	4.2	12.2	6.6
	52141	♂	17.2	9.6	4.2	6.2	8.2	14.5	6.2	6.8	4.2	12.4	6.6
Colima: Colima	52068	♂	17.0	9.5	4.2	6.0	8.2	14.0	6.2	6.5	3.8	12.2	6.6
	52070	♀	16.4	9.0	4.0	6.0	8.0	14.2	6.0	6.4	3.8	11.5	6.2
	52071	♀	16.4	------	4.0	------	------	------	6.0	6.4	3.6	11.2	6.0
	52072	♂	16.8	------	4.0	5.8	8.2	14.2	6.2	6.6	4.0	12.5	6.5
Michoacan: La Palma	112188	♀	16.4	9.0	3.8	6.0	8.0	14.2	6.0	6.5	3.6	11.2	6.2
	112190	♀	17.2	9.5	4.2	5.8	8.2	14.4	6.2	6.8	4.0	12.0	6.6
	112191	♂	17.0	9.2	4.0	6.2	8.2	14.6	6.2	6.4	3.8	12.0	6.6
Jalisco: Huejuguilla	92494	♀	16.6	9.4	3.8	5.8	8.4	14.2	6.2	6.4	3.6	12.0	6.6
	92495	♀	17.0	9.5	4.2	6.0	8.2	14.2	6.2	6.6	3.8	11.8	6.4
	92496	♀	16.8	9.6	4.0	5.8	8.0	14.2	6.0	6.4	4.0	12.0	6.4
Coahuila: Sabinas	117119	♂	16.6	9.5	4.2	6.2	8.2	14.0	6.0	6.8	4.2	11.6	6.2
	117120	♂	17.0	9.5	4.2	6.2	8.4	14.2	6.0	6.8	4.2	11.6	6.4
	117122	♀	17.0	9.5	4.2	6.0	8.2	14.2	6.0	6.5	4.0	11.5	6.4
	117123	♀	17.0	9.6	4.2	6.0	8.2	14.0	6.2	6.8	4.2	11.5	6.8
	117124	♀	16.4	9.2	4.0	6.0	8.2	13.4	5.5	6.6	3.8	10.5	6.0
	117125	♀	17.0	9.2	4.0	6.4	8.2	14.2	6.0	6.6	4.0	11.4	6.5
Durango	132499	♀	16.2	9.2	3.8	5.8	8.0	13.4	5.8	6.6	3.8	11.5	6.2
Sinaloa: Culiacan	96900	♂	16.6	9.2	4.0	6.0	8.2	13.6	6.0	6.6	4.0	11.8	6.5
Mexico: Tampico	22104	♀	16.4	9.2	4.2	6.2	8.2	13.8	6.0	6.6	4.0	11.4	6.4
	22126	♀	16.4	------	4.0	5.6	8.2	14.2	5.8	6.5	3.8	11.6	6.4
	22187	♀	16.4	------	4.0	5.8	8.0	13.5	5.8	6.8	4.2	11.6	6.2
	22188	♀	16.5	9.5	4.0	6.2	8.0	13.8	6.0	6.5	3.8	11.8	6.4
	22191	♀	16.4	9.2	4.2	6.2	8.2	14.0	5.8	6.4	3.6	11.8	6.2
	22194	♀	16.5	------	4.0	6.0	8.2	13.6	6.0	6.5	3.8	12.0	6.4
Texas:													
Brazos	118405	♂	16.6	9.2	4.2	6.0	8.0	14.2	6.0	6.8	4.2	12.2	6.5
	118407	♂	16.8	------	3.8	5.8	8.2	14.2	6.0	6.6	4.2	12.4	6.4
	118408	♀	16.8	9.2	4.2	------	8.4	14.2	5.8	6.4	4.0	11.6	6.4
	118409	♀	16.8	9.2	4.2	6.0	8.4	14.5	6.0	6.4	4.0	12.0	6.4
	118410	♀	16.8	8.8	4.2	6.2	8.2	14.2	5.8	6.4	------	12.2	6.4
Kerrville	97054	♀	16.6	9.5	4.0	6.0	8.2	13.8	5.8	6.6	4.0	11.8	6.4
	97057	♂	17.2	9.6	4.0	6.2	8.2	14.2	6.2	6.6	4.0	12.2	6.5
	97058	♂	17.2	9.6	3.8	6.2	8.2	14.5	6.0	6.8	3.8	11.8	6.4
	139269	♂	17.2	9.4	4.0	6.2	8.0	14.5	6.2	6.8	3.8	12.2	6.6
Davis Mountains, New Mexico:	110404	♂	17.2	9.6	4.0	5.8	8.4	14.4	6.2	6.5	3.6	11.8	6.4
Cloverdale Hills	157598	♂	16.8	------	4.2	------	8.4	------	6.0	6.6	4.0	12.0	6.4
	157601	♂	16.8	9.2	4.0	5.8	7.8	14.2	5.8	6.4	4.0	12.2	6.2
Animas Valley	157390	♂	17.0	------	4.0	6.0	8.2	14.2	6.2	6.5	3.6	11.8	6.2
Carlsbad Cave	244467	♀	17.2	9.8	4.2	6.0	8.2	14.4	6.2	6.8	3.8	12.4	6.4
	244468	♂	17.2	9.4	3.8	6.2	8.4	14.2	6.0	6.8	3.8	12.2	6.6

[1] Type.

Cranial measurements of the brasiliensis group—Continued

TADARIDA MEXICANA—Continued

Locality	No	Sex	Total length	Zygomatic breadth	Interorbital breadth	Occipital depth	Breadth of braincase	Basal length	Maxillary toothrow	Breadth at M^2	Breadth at canines	Length of mandible	Mandibular toothrow
Arizona:													
Yuma	136127	♂	17.0	9.8	4.0	6.0	8.2	14.5	5.8	6.8	4.5	12.0	6.4
	136130	♀	16.6	------	4.2	5.8	8.4	14.2	6.2	6.8	------	11.8	6.5
Indian Oasis	229312	♀	16.5	9.2	4.0	6.5	8.2	14.2	5.8	6.5	3.8	11.8	6.4
Safford	204294	♀	16.6	9.4	4.0	6.2	8.2	14.4	6.2	6.5	4.2	11.6	6.6
California:													
Gilroy	150825	♂	17.2	9.4	4.0	6.2	8.5	14.6	6.0	6.8	4.2	12.2	6.6
San Jose	55576	----	17.2	9.2	4.2	6.4	8.4	14.4	6.0	6.6	4.0	11.8	6.6
	55577	----	17.4	9.4	4.0	5.8	8.5	14.5	6.4	6.8	4.2	11.8	6.6
Lemoore	77453	----	16.4	9.2	4.2	5.5	8.0	13.8	6.2	6.6	3.8	11.5	6.5
	77456	----	16.4	------	4.0	5.5	------	13.6	5.8	6.2	------	11.6	6.0
Colusa	133279	♂	17.2	9.2	3.8	6.0	8.0	14.5	6.2	6.4	3.8	12.2	6.8
	133281	♀	17.5	9.5	4.0	6.0	8.2	14.6	6.2	6.6	4.0	12.5	6.4
	133282	♂	17.8	9.6	4.2	5.0	8.6	14.8	6.2	6.8	------	12.2	6.8
	133284	♂	17.4	9.6	4.2	5.6	8.2	14.4	6.2	6.8	4.4	12.0	6.6
	133285	♂	17.2	------	3.8	6.0	8.2	14.5	6.2	6.5	4.0	11.8	6.8
	133286	♂	17.2	9.6	4.0	5.8	8.8	14.4	6.5	6.8	4.5	12.4	7.0
	133288	♀	16.8	9.2	3.8	5.6	8.2	14.4	6.0	6.6	4.4	12.2	6.6

TADARIDA CYNOCEPHALA

Louisiana:													
Morgan City	247029	----	17.5	------	4.2	6.4	8.4	14.6	6.2	6.8	4.2	12.8	6.8
	247031	----	17.5	------	4.2	6.4	8.5	14.8	6.4	6.8	------	12.6	7.0
	247032	----	17.5	------	4.2	6.4	8.8	14.6	6.2	6.8	4.4	12.8	6.8
Baton Rouge	180902	♀	17.5	------	3.8	6.2	8.2	14.8	6.2	------	4.4	12.4	6.8
	180903	♂	17.8	10.0	4.6	6.4	8.8	14.8	6.2	7.0	4.4	12.4	6.8
Houma	52869	♂	17.6	------	4.4	6.2	8.6	14.6	6.2	7.0	4.2	12.4	6.8
	52872	♀	17.2	10.0	4.5	6.2	8.2	14.4	6.2	6.8	4.2	12.2	6.8
	52873	♀	17.2	10.2	4.2	6.2	8.8	14.5	6.2	------	4.2	12.5	6.6
Alabama: Orange Beach	178258	♀	17.5	------	4.2	6.5	8.5	14.5	6.2	6.8	4.2	12.6	6.6
	178001	♂	17.0	------	4.2	6.0	8.8	14.0	6.0	7.0	4.2	12.2	6.6
Georgia: Savannah	159414	♂	18.0	9.8	4.2	6.6	8.5	15.2	6.2	7.0	4.6	12.8	7.0
South Carolina: Columbia	71615	♀	17.4	10.2	4.2	6.2	8.6	14.8	6.2	6.8	4.2	12.2	6.6
	71620	♀	17.2	------	------	------	8.6	------	6.2	------	------	12.2	6.6
Florida: Gainesville	239253	♂	18.0	10.0	4.2	6.4	8.8	15.0	6.5	7.2	4.2	12.6	7.0
	239254	♂	17.5	------	4.4	6.2	8.2	------	6.0	7.2	4.6	12.6	6.8
	239255	♂	------	10.4	4.2	6.4	8.4	14.0	6.0	7.2	4.6	12.5	6.4
	239256	♂	17.2	9.8	4.0	6.2	8.5	14.4	6.0	7.0	4.5	12.5	6.8
	239257	♂	17.2	9.5	4.0	6.2	8.5	14.6	6.0	7.0	4.4	12.4	6.5
	239262	♀	17.5	9.5	4.2	6.2	8.5	14.6	6.4	6.8	4.2	12.8	6.8
	239263	♀	17.4	9.8	4.0	6.4	8.5	14.5	6.2	7.0	4.4	12.5	6.8
	239264	♀	------	9.6	4.2	6.2	8.2	------	6.2	6.8	4.4	12.2	6.6
	239265	♀	17.2	9.2	4.2	6.2	8.5	14.0	6.2	6.8	4.4	12.2	6.6
	239266	♀	17.5	------	4.4	6.4	8.8	14.5	6.2	6.8	4.2	------	------
	239267	♀	------	------	4.2	6.2	8.6	14.0	6.0	6.8	------	11.6	6.8

TADARIDA BAHAMENSIS

Bahama: Long Island	122025	♀	16.8	9.4	3.8	6.0	7.6	14.2	6.0	6.6	4.5	12.0	6.5
	122026	♂	16.6	9.0	3.8	6.0	7.8	14.2	6.0	6.5	4.0	11.6	6.5
	122027	♂	------	9.4	3.6	------	7.8	------	5.8	6.5	4.2	11.8	6.5
	122028	♂	16.5	9.2	4.0	6.0	7.8	13.8	5.6	6.6	4.5	11.8	6.5
	122029	♀	16.5	9.5	3.8	6.0	8.0	14.0	5.6	6.5	4.0	11.5	6.2
Bahama Islands	217273	♀	16.6	9.0	3.8	5.8	7.6	14.0	6.0	6.5	4.0	12.0	6.2
	217281	♀	16.0	8.8	3.8	5.6	7.8	13.6	5.6	6.4	3.6	11.8	6.2
	217288	♀	16.5	9.0	3.8	------	------	------	5.8	6.4	3.6	12.0	6.2
	217289	♀	16.0	9.0	3.8	5.8	7.6	13.6	5.8	6.2	3.8	11.6	6.2
	217291	♀	16.6	9.2	3.8	6.2	8.0	14.0	5.8	6.6	3.6	11.8	6.2
	217292	♀	16.0	9.0	3.6	5.8	7.8	13.6	5.8	6.2	3.5	11.6	6.2

Cranial measurements of the brasiliensis group—Continued

TADARIDA CONSTANZAE

Locality	No.	Sex	Total length	Zygomatic breadth	Interorbital breadth	Occipital depth	Breadth of braincase	Basal length	Maxillary toothrow	Breadth at M^3	Breadth at canines	Length of mandible	Mandibular toothrow
Haiti:													
Bombardopolis	218198	♂	16.5	9.0	3.8	6.2	8.0	13.6	5.6	6.4	4.0	11.5	6.0
San Michel	240924	----	16.6	9.5	4.0	6.0	8.2	14.0	6.0	7.0	4.2	------	------
Do	240925	♂	16.4	9.0	4.0	6.2	7.6	14.0	5.6	6.5	4.0	11.4	6.0
Santo Domingo: Constanza	217150	♀	16.0	9.2	4.0	6.0	8.0	13.6	5.6	6.5	3.8	11.2	6.2
	217158	♀	16.0	8.5	3.6	6.0	7.6	13.5	5.6	6.5	4.0	11.0	6.5
	217170	♀	16.0	------	3.8	6.0	8.2	13.2	5.6	------	------	11.8	6.0
	217184	♂	16.0	9.0	3.8	5.6	8.0	13.6	5.6	6.5	------	11.2	6.2
	217199	♀	16.2	9.2	4.2	------	8.2	------	5.6	6.6	3.6	11.4	6.2
	[1]217205	♂	16.5	8.8	3.8	5.8	7.8	13.8	5.6	6.4	3.8	11.4	6.2
	217245	♀	16.4	8.8	3.8	6.0	7.8	------	5.8	6.6	4.0	11.6	6.2

TADARIDA MUSCULA

Cuba	103775	♂	16.0	8.8	3.6	6.0	7.6	13.2	5.0	6.4	4.0	11.4	6.0
	103777	♂	16.4	9.0	4.0	6.0	7.8	14.0	5.8	6.5	4.2	11.8	6.2
	103778	♀	16.4	9.2	3.6	6.0	8.0	13.7	5.6	6.4	3.8	11.2	6.2
	103779	♀	16.2	8.8	4.0	6.6	7.6	13.2	5.6	6.4	3.6	11.0	6.2
	103780	♀	16.0	8.5	4.0	5.8	7.8	13.5	5.6	6.2	3.6	11.4	6.0
	143846	♀	16.0	------	4.0	5.6	7.8	13.2	5.6	6.2	4.0	11.8	6.2

TADARIDA MURINA

Jamaica	96190	♀	16.2	9.2	3.6	6.2	7.8	13.2	5.5	6.5	3.5	11.2	6.0
	102519	♂	16.0	8.5	3.6	6.0	7.6	13.5	5.6	6.6	3.6	11.4	6.2
	122425	♂	16.4	------	4.0	6.2	8.2	13.8	5.5	6.6	3.8	11.2	6.2
	122426	♀	16.6	------	4.0	6.0	8.2	14.0	5.8	6.6	4.0	11.5	6.2
	122427	♂	16.2	9.2	3.8	6.2	7.8	13.8	5.6	6.5	3.8	11.4	6.2

TADARIDA ANTILLULARUM

Porto Rico:													
Adjuntas	86337	♂	15.6	8.8	4.0	5.8	7.6	13.4	5.6	6.4	3.8	10.5	6.2
	86339	----	16.0	9.0	4.0	6.0	8.0	13.4	5.5	6.5	3.5	11.2	6.2
	86340	----	15.6	8.6	3.6	6.0	7.5	13.0	5.4	6.4	3.6	11.0	6.0
Cayuas	86345	♂	15.8	------	4.0	6.0	7.8	13.4	5.5	6.4	3.8	11.0	6.0
Mayaquez	112108	♀	------	9.2	3.8	6.0	7.6	13.5	5.6	6.5	4.0	11.2	6.0
	112109	♀	------	9.0	4.2	------	------	------	5.4	6.5	3.6	11.4	6.0
West Indies:													
St. Kitts	86869	♂	16.0	8.8	3.6	5.8	7.5	13.2	5.5	6.4	3.8	11.0	6.0
	86870	♀	15.8	8.6	3.6	5.8	7.6	13.4	5.6	6.4	4.0	10.6	5.8
Barbuda	123240	♂	15.8	------	3.6	5.8	7.5	13.5	5.6	6.2	3.5	11.6	6.2
	123241	♀	15.0	------	3.6	5.5	7.2	12.8	5.4	6.6	3.4	10.6	5.6
	123244	♂♀	15.5	------	3.6	5.6	7.6	12.8	5.6	6.0	3.2	10.6	5.8
Montserrat	101580	♂♀	15.6	8.8	3.6	5.8	7.4	13.2	5.5	6.2	4.0	11.2	5.8
St. Lucia	110906	♀	15.0	------	3.6	------	7.4	------	5.4	6.2	3.6	10.8	5.6
	110907	♀	15.8	------	3.8	5.6	7.5	13.0	5.6	6.4	3.6	11.4	6.2
	110914	♀	15.5	------	3.6	------	------	------	5.6	6.0	3.8	11.4	6.2
	110915	♂	16.0	9.2	3.8	5.8	7.8	13.4	5.4	6.2	4.0	11.6	5.8
West Indies: Antigua (English Harbor)	219311	♀	15.6	9.0	3.5	5.8	7.5	13.5	5.5	6.4	3.8	11.2	6.2
	219313	♀	16.2	9.2	3.6	6.2	7.8	13.6	5.5	6.5	3.6	11.0	6.0
	219314	♀	15.8	9.0	3.6	6.0	7.5	13.2	5.5	6.5	4.0	11.4	6.2
	219316	♀	16.2	8.8	3.6	5.8	7.6	13.5	5.6	6.4	3.8	11.2	6.0
	219320	♀	16.0	9.0	3.6	6.2	7.5	13.4	5.6	6.4	3.8	11.0	6.2
Guadeloupe	113525	♂♀	15.8	9.0	------	------	7.8	------	5.8	6.5	4.2	11.8	6.2
	113527	♂♀	16.0	9.5	3.8	6.0	7.6	13.5	5.8	6.5	4.4	11.4	6.2
	113531	♀	------	9.2	3.5	5.6	7.8	------	5.8	6.4	4.0	11.5	6.2
	113532	♀	16.2	9.2	3.8	6.2	7.8	14.0	5.6	6.6	4.0	11.4	6.2
	113533	♀	16.4	9.4	3.6	6.2	7.6	13.6	5.8	6.4	4.0	11.2	6.2
	113534	♂	16.5	9.5	3.8	6.0	8.0	14.2	5.8	6.6	4.0	11.8	6.4
Dominica: Roseau	113188	♂	16.0	8.8	3.6	5.8	7.6	13.2	5.5	6.2	3.8	11.0	6.2
West Indies:													
Dominica	113635	----	15.8	8.8	3.6	5.8	7.6	13.2	5.6	6.5	4.0	10.6	6.0
	113637	----	14.6	8.5	3.6	5.6	7.4	12.6	5.5	5.6	3.6	10.2	5.6
	113640	♂	15.8	9.0	3.6	5.6	7.5	13.0	5.6	6.2	3.6	11.2	5.8
	113644	♀	15.5	8.6	3.6	5.6	7.5	13.0	5.5	6.2	3.8	10.6	5.8
	113646	♀	15.8	8.8	3.5	5.8	7.5	13.2	5.6	6.2	3.8	10.5	6.0
La Haut	113187	----	14.8	8.4	3.6	5.6	7.4	12.6	5.4	6.2	3.6	10.5	5.6

[1] Type.

Cranial measurements of the macrotis group

TADARIDA LATICAUDATA

Locality	No.	Sex	Total length	Zygomatic breadth	Interorbital breadth	Occipital depth	Breadth of braincase	Basal length	Maxillary toothrow	Breadth at M^3	Breadth at canines	Length of mandible	Mandibular toothrow
Paraguay:													
Villa Rica	114952	♀	19.5	10.5	4.2	7.0	9.2	16.4	7.2	7.5	4.4	14.0	7.6
Sapucay	114953	♂	18.8	9.8	3.8	6.4	8.8	15.6	6.8	7.2	4.0	13.2	7.5
	114954	♂	19.5	10.0	4.0	6.8	8.8	16.2	7.2	7.2	4.2	13.4	7.6
	114955	♀	18.6	10.2	3.8	6.4	9.0	15.6	7.2	7.4	3.8	13.6	7.5
	114956	♂	19.0	10.0	4.0	7.0	9.0	15.8	7.2	7.4	4.0	13.2	7.5
	114957	♀	19.0	10.2	3.8	6.6	8.8	15.5	7.0	7.2	4.0	13.2	7.2
	114958	♀	18.6	9.5	3.8	6.5	8.8	------	6.8	7.2	3.8	13.2	7.2
	114964	♀	18.5	9.8	3.8	6.6	9.0	15.2	6.8	7.5	4.0	12.5	7.2

TADARIDA FEMOROSACCA

Arizona:													
Fort Huachuca	36038	♀	19.2	9.6	3.8	6.0	8.8	16.2	7.2	7.2	3.6	13.2	7.8
	20922												
Coyote Mountains	209318	♀	19.2	9.6	3.8	6.2	9.2	16.2	7.5	7.2	3.8	13.5	7.6
Lower California:													
Santa Anita	96486	♀	18.4	------	3.6	6.2	8.8	------	7.0	6.6	3.2	12.5	7.2
San Pedro Mountains	38919	♂	19.4	9.8	4.0	6.2	9.0	16.5	7.2	6.6	3.8	13.8	7.6
	22458												
Jalisco:													
Zacoalco	51521	♂	------	10.4	3.8	------	9.0	------	7.2	7.2	4.2	14.2	7.8
	51520	♂	19.2	10.4	3.8	6.4	9.2	16.8	7.4	7.0	4.4	14.0	7.8

TADARIDA YUCATANICA

Yucatan:													
Chichen Itza	108156	♂	18.0	9.5	4.0	------	8.6	------	6.6	6.6	3.6	13.2	7.2
	108157	♂	18.0	9.4	3.8	6.4	8.5	15.0	6.5	6.6	3.8	12.6	7.2
	108158	♂	18.2	9.6	4.0	6.5	8.6	15.2	6.8	6.8	3.8	12.6	4.4
	108161	♀	17.8	9.6	3.6	6.5	8.4	14.8	6.4	6.4	3.8	12.6	7.0
	108162	♀	17.8	9.2	3.8	6.5	8.5	14.6	6.5	6.4	3.6	12.2	7.0
	108163	♀	18.0	9.6	4.0	6.4	8.4	15.2	6.6	6.8	3.6	12.4	7.2
	108164	♀	17.6	9.4	3.8	6.5	8.8	14.5	6.4	6.2	3.5	12.6	7.2
	108165	♀	17.8	9.8	3.8	6.4	8.8	14.6	6.5	6.8	3.8	12.6	6.8
	[1] 108166	♀	17.8	9.4	3.6	6.2	8.6	14.6	6.4	6.6	3.5	12.6	7.0

TADARIDA EUROPS

Brazil	101492	♀	16.6	9.0	3.6	6.2	7.6	13.5	6.2	6.6	3.4	11.2	6.6
	101493	♀	16.6	9.4	3.4	6.2	8.2	13.6	6.4	6.6	3.6	11.8	6.6
	101495	♀	17.0	9.0	3.4	6.2	8.0	13.8	6.2	6.2	3.5	11.8	6.6
	101496	♀	17.2	9.4	3.4	6.4	8.2	14.2	6.2	6.6	------	12.5	6.6
	101502	♀	16.5	9.2	3.5	6.4	8.2	13.8	6.2	6.6	3.4	12.2	6.6
	[2] 101498	♀	16.6	9.2	3.4	6.2	8.2	13.6	6.4	6.5	3.4	12.2	6.6

TADARIDA MACROTIS

Jamaica	96192	♂	22.2	11.6	4.2	7.5	10.0	19.5	8.8	8.2	4.6	16.0	9.2
	96194	♂	------	------	------	------	------	------	8.8	------	------	16.4	9.2
	122655	♂	22.6	11.5	4.4	7.8	10.0	20.0	8.8	7.8	4.6	16.4	9.4
Dominican Republic	105696	♀	------	------	4.2	------	------	------	8.2	8.0	4.5	16.0	9.0
	105697	♀	22.6	10.6	4.2	7.6	10.4	19.5	8.5	7.6	4.5	16.2	8.8
	105700	♂	------	------	------	------	------	------	8.8	------	------	16.2	9.6
	105701	♂	23.4	11.5	------	------	------	20.6	9.0	8.2	4.5	16.5	9.4
	105702	♂	------	------	------	------	------	------	8.8	8.2	4.5	16.5	9.4
	105703	♂	------	------	------	------	------	------	8.8	------	4.6	16.5	9.5
California	[3] 36569	♀	22.4	10.5	4.2	7.2	10.0	19.4	8.4	7.6	4.2	15.8	9.0
	15178												
Lower California:													
Santa Anita	96487	♂	23.6	10.4	4.4	7.5	10.4	20.4	8.8	7.6	4.4	16.6	9.8
	96488	♂	22.6	------	4.2	7.5	10.0	20.2	8.6	7.6	4.2	17.0	9.4
	96489	♂	23.6	10.2	4.2	6.8	10.2	20.4	8.8	7.4	4.2	16.8	9.5
	148549	♂	24.0	11.4	4.5	7.8	10.2	20.8	8.6	8.0	4.5	17.4	9.8
Arizona: Chiricahua Mountains (A. M. N. H.)	6740	♀	23.5	11.5	4.4	7.5	10.4	20.6	9.0	8.2	5.2	17.0	9.5
Iowa: Marshalltown (F. M.)	21819	----	23.6	11.0	4.4	------	10.4	------	9.0	7.4	4.4	16.6	9.2
Brazil: Ypiranga	200994	[4] ♀	22.6	------	4.5	7.4	10.2	19.6	8.8	8.0	4.5	16.4	9.2
Surinam (B. M.)	[5]	♂	24.0	13.0	------	------	10.4	------	9.0	------	------	17.0	9.8
Ecuador: Manavi Chone (A.M.N.H.)	[6] 34383	----	24.0	11.5	4.2	7.8	10.2	21.0	9.5	8.5	4.8	17.6	9.8

[1] Type of *Nyctinomus yucatanica*.
[2] Lectotype.
[3] Type of *Nyctinomus nevadensis*.
[4] Young.
[5] Type of *Nyctinomus megalotis*, measurements taken by G. S. Miller, jr., 1904.
[6] Type of *Nyctinomus equatorialis*.

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A NEW PARASITIC FLY OF THE GENUS CHAETOPHLEPSIS

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The new species described in this paper was recognized in the course of parasite work at the gypsy moth laboratory of the Bureau of Entomology. The writer wishes to acknowledge the technical assistance which he received from Dr. J. M. Aldrich, of the United States National Museum, during the preparation of this description and the notes which accompany it.

According to Aldrich,[1] the genus *Hypochaeta* Brauer and Bergenstamm does not occur in the United States and the species assigned to that genus by Coquillett [2] and Smith [3] should be referred to *Chaetophlepsis* Townsend.[4] In assigning Smith's species to *Chaetophlepsis*, Aldrich recognized but one of them, *townsendi*, as valid; the other, *eudryae*, he made a synonym of *C. tarsalis* Townsend. A study of more material from the gypsy moth laboratory, Melrose Highlands, Mass., confirms Aldrich's synonymy in part. It appears that the type material of *Hypochaeta eudryae* Smith is a mixture of two species. The holotype (from *Eudryas grata*, Newton, Mass.) and one paratype (White Mountains, H. K. Morrison) are identical with *C. tarsalis*, while the remaining paratypes (Oswego, N. Y., 1897) represent a new species.

The males of this new species are readily differentiated from the others of the genus by their well-developed orbital bristles, wider front, and shorter pulvilli. The females are more difficult, but the wider front, shorter antennae, and distinctive reddish-yellow base of the third antennal joint will serve to separate them from *tarsalis*. The female of *townsendi* is unknown.

[1] Proc. Ent. Soc. Wash., vol. 25, 1923, p. 161.
[2] U. S. Dept. Agr. Div. Ent., Tech. Ser. 7, 1897, p. 65.
[3] Proc. Ent. Soc. Wash., vol. 18, 1916, p. 94.
[4] Proc. U. S. Nat. Mus., vol. 49, no. 2115, 1915, p. 422.

CHAETOPHLEPSIS ORBITALIS, new species

Male.—Front, at vertex, 0.42 of the head width (measurements of three as follows: 0.41, 0.42, 0.43); inner orbits equidistant from vertex to base of antennae, thence gently divergent, entire front grayish pollinose, concolorous; frontalia broad, wider than the parafrontals; frontal rows of four or five strong bristles extending below base of third antennal joint; ocellar bristles erect, directed outward and a little backward; two pairs of strong orbital bristles; inner vertical bristle well-developed. Face grayish pollinose, receding, facial plate sunken; facial ridges bristly three-fourths way from vibrissae to base of antennae; parafacial narrow, less than one-half the width of the third antennal joint; vibrissae at the oral margin; bucca slightly over one-third the eye height; two geno-orbital bristles. Antennae inserted high above middle of eye; first and second joints black, short; third joint black, broad, and seven or eight times the length of the second; second joint of the arista short, the third thickened for about one-half its length and gradually tapering therefrom. Eyes indistinctly short hairy. Palpi yellow, the proboscis short.

Thorax black, heavily gray pollinose and with a brassy cast, the vittae indistinct; three postsutural dorsocentral bristles; two sternopleural bristles; no pteropleural bristle. Scutellum with two lateral bristles on either side, a strong decussate apical and a small discal pair of bristles.

Abdomen black, gray pollinose with a faint brassy tinge; abdominal hairs depressed; first segment with a lateral macrochaeta only; second segment with two lateral, one discal pair, and one marginal pair; third segment with three lateral, one discal pair, and one marginal pair and the fourth segment with a discal pair and a complete marginal row. Viewed from behind, the fourth segment is wedge-shaped, the posterior margins not contiguous, hence exposing the large, elongated first genital segment. This segment is not retractile, thickly gray pollinose and sparsely beset with fine black hairs; second genital segment small; inner forceps curved under, piercerlike in appearance, and about equal in length to the first genital segment, outer forceps elongate with rounded ends which terminate acutely.

Legs robust, black; tibiae brownish; front tibiae with two posteroventral bristles near the middle and a row of bristles in front; middle tibiae with a stout anterodorsal bristle at about the middle and a weaker one above it, also an inner bristle; hind tibiae with seven or eight short and long bristles on the outer hind side; all the pulvilli short.

Wings hyaline; apical cell open, ending a little way before wing tip; first vein bristly from base to apex; third vein at base with three bristles, the outermost ones strongest and unusually long; costal spine appressed. Hind cross vein retracted, the last section of the first vein considerably more than one-half the preceding.

Female.—Front, at vertex, 0.40 of the head width (measurement of three as follows: 0.39, 0.39, 0.41); part of the second and base of third antennal joint reddish yellow; third joint mostly black, five times the length of the second; otherwise, except for the genitalia, like the male.

Length, 5 to 7 mm.

The species is represented by large series of both sexes and there appears to be but little variation. Ocassionally the males will show a little red on the first two antennal joints and a few specimens have the frontal vitta a little more yellowish than the parafrontals. As a rule the arista is thickened from one-third to one-half the way from the base and gradually tapers therefrom. Rarely is there any abrupt tapering. There are usually two (rarely one) midtibial bristles, often three in the females; hind cross vein retracted, but the distance from its end to the small cross vein is variable. The number and position of the geno-orbital bristles vary. Costal spine usually appressed, sometimes upright and distinct. The anal cell open or closed. There is also minor variation in the abdominal macrochaetae.

Puparium.—The puparium has been described by Greene[5] under the name of *Hypocheata longicornis* Schiner.

Biology.—Only a few facts concerning the biology of the species are known. Usually there is a single generation, but occasionally adults will emerge in the late summer of the same year in which the puparia are formed and possibly a partial second generation ensues. The species passes the winter in an undeveloped state within the puparium.

Described from 25 specimens of both sexes reared at the gipsy moth laboratory from *Cingilia catenaria* Drury, by J. V. Schaffner, jr., and others. The type (G. M. L. 12418 J3*a*) is from Sherborn, Mass.: emergence date, April 21, 1924. The allotype (G. M. L. 12418J3) from Sherborn, Mass.; emergence date, April 24, 1924. The paratypes are as follows: 4 males, Sudbury, Mass., June 2, 4, 4, 4, 1923 (G. M. L. 12418 H2); 4 males, Sherborn, Mass., June 2, 2, 4, 4, 1923 (G. M. L. 12418 H1A); 3 males, Brewster, Mass., June 2, 4, 4, 1923 (G. M. L. 12418 H3); 1 female, Lancaster, Mass., May 20, 1929 (G. M. L. 12418 P 2); 2 females, Amherst, N. H., May 16, 17, 1929 (G. M.

[5] Proc. U. S. Nat. Mus., vol. 60, no. 2405, art. 10, 1921, p. 28.

L. 12418 P1); 1 female, Westerly, R. I., May 18, 1921 (G. M. L. 12418 F3); 2 females, Sudbury, Mass., June 17, 17, 1924 (G. M. L. 12418 J2); 2 females, Sherborn, Mass., April 24, 24, 1924 (G. M. L. 12418 J3); 4 females, Sherborn, Mass., April 23, 24, 24, 24, 1924 (G. M. L. 12418 J3A). Four of the paratypes are at the gypsy moth laboratory. The remainder of the type material is in the United States National Museum. Other material examined consist of 237 specimens of both sexes reared at the gipsy moth laboratory from *Cingilia catenaria* Drury from New England localities and several specimens in the United States National Museum from New York, Maryland, and New Hampshire.

Type.—Male. Cat. No. 43135, U.S.N.M.

NOTES ON CHAETOPHLEPSIS TARSALIS TOWNSEND

Townsend described only the female of *tarsalis*, and while this description will suffice for the male, some additional notes may prove of value. The species is represented at the gipsy moth laboratory by about 60 specimens of both sexes, reared from *Alypia octomaculata* Fabricius by J. V. Schaffner, jr., and others.

Front at vertex in six males varying from 0.31 to 0.33 of the head width; in the females from 0.32 to 0.33; geno-orbital bristles variable; frontalia usually more yellowish pollinose than the parafrontals, often concolorous; males usually with one strong, outer midtibial bristle, sometimes with two; female invariably with two strong ones; third antennal joint of male about six or seven times the second, in the female a little shorter; second antennal joint usually black, occasionally a little reddish but never conspicuously so; hind cross vein retracted, distance from end to small cross vein variable but never ending beyond the middle of fifth vein; male pulvilli as long as the last tarsal joint.

Distribution.—Peru, Colorado, New Hampshire, New York, Massachusetts, and Mississippi.

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DESCRIPTION OF A NEW SPECIES OF AMIDOSTOMINE WORM OF THE GENUS EPOMIDIOSTOMUM FROM THE GIZZARD OF ANSERINE BIRDS

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From the gizzard of a Canada goose (*Branta canadensis canadensis*) forwarded to the Zoological Division of the Bureau of Animal Industry by W. L. McAtee, of the Bureau of Biological Survey, there were collected, in addition to numerous specimens of *Amidostomum anseris*, a few specimens of a new trichostrongyle. The worm belongs to the subfamily Amidostominae Travassos, 1919, and to the genus *Epomidiostomum* Skrjabin, 1916. For this species the name *Epomidiostomum crami* is proposed.

An examination of the Helminthological collection of the Bureau of Animal Industry showed the presence of the same species in a bottle labelled No. 28959. The material was collected by E. B. Cram from the gizzard of a blue goose, *Chen caerulescens*, from the National Zoological Park, Washington, D. C. In another bottle, No. 28964, of specimens collected by E. B. Cram from a cinnamon teal, *Querquedula cyanoptera*, also from the National Zoological Park, I found another species of *Epomidiostomum*, which I determined as *Epomidiostomum uncinatum* (Lundahl, 1848) Seurat, 1918, the type species of the genus. This is the first report of *E. uncinatum* collected in America, this species being previously reported only from Europe, Africa, and Asia. In view of some differences in the descriptions, especially concerning the head end and the bursal rays, as given by Skrjabin (1916) and by Seurat (1918), I include in this paper a description of *E. uncinatum* based on the present material.

The characters of the genus *Epomidiostomum* as given by Cram (1927) after Skrjabin (1916) and Seurat (1916) are as follows:

Genus EPOMIDIOSTOMUM Skrjabin, 1916

Figures 4–6; Figures 11–12

Generic diagnosis.—Amidostominae: Meromyarian. Body filariform, the anterior extremity attenuate. Cuticle thick and transversely striated. Post-cervical papillae present, but not prominent. Head distinct, bearing on its dorsal and ventral surface a pair of

No. 2864.—Proceedings U. S. National Museum, Vol. 78, Art. 21.
23913—31

nodules (also referred to as lips or papillae), which are directed posteriorly and are either uncinate or obtuse at their free extremity. According to Seurat, the head bears a pair of lateral papillae on each side. Cephalic cuticle ornamented with a pair of epaulets or festoons, which, according to Skrjabin, have zig-zag incisions in their posterior portion. Buccal capsule lacking, according to Skrjabin, or short and reduced, according to Seurat. Esophagus with three chitinous axial lamellae. *Male* with uncinate tail, concave ventrally, with a bursa which, according to Skrjabin, is delicate, or, according to Seurat, has thick lateral lobes marked with a strong reticulate striation and folded over each other ventrally. The ventro-ventral and the latero-ventral rays are in relation with each other as opposed to the other bursal rays; Seurat says they are parallel, but Skrjabin says they are separated and figures them as slightly divergent. According to Seurat, the postero-lateral and medio-lateral rays are slender, contiguous, and elongate, and the externo-lateral ray is short; according to Skrjabin, the externo-lateral ray is related to the two other lateral rays, which are so united as to leave only a slight cleft between them; Skrjabin's figure indicates that the lateral rays have a common stem which divides to form the externo-lateral ray and the common stem of the two other laterals and that this latter common stem divides a half to two-thirds of its length from its base to form these two rays. The externo-dorsal ray is short and massive, originates directly at the tip of the tail, and does not reach the bursal margin. The dorsal ray, in the type species, divides dichotomously distally to form four small tips and is the only ray in relation with the small dorsal lobe of the bursa. There are two voluminous sessile papillae, contiguous or almost so, on the posterior lip of the cloaca. A pair of briefly pedunculated prebursal papillae present. Spicules equal and short, each dividing distally, in the type species, to form one dorsal and two latero-ventral branches. No telamon (or gorgeret) present. *Female* with vulva posterior to middle of body. Branches of ovejector divergent or parallel. Uteri opposed. Eggs segmenting when deposited. Parasitic in corneus tunic of gizzard in palmipeds.

Type species.—Epomidiostomum uncinatum (Lundhal, 1848) Seurat, 1918.

EPOMIDIOSTOMUM UNCINATUM (Lundahl, 1848) Seurat, 1918

Plate 1, figs. 4–6; Plate 2, figs. 11–12

Synonyms.—Strongylus uncinatus Lundahl, 1848; *Epomidiostomum anatinum* Skrjabin, 1916.

Specific diagnosis.—Epomidiostomum: The body is slender, attenuated anteriorly, the striations being more developed in the neck region. The postcervical papillae, about 450μ posterior to the head

end, are inconspicuous. The excretory pore opens at a distance of about 400μ to 430μ from the anterior end of the body.

The head, distinctly set off from the body proper, is about 30μ wide. It shows a special cuticular expansion forming two lateral plates, and one dorsal, and one ventral plate. The lateral plates are not so conspicuous; both the dorsal and the ventral plate, which have the shape of a spheric triangle, are more prominent. The front surface of the head is supplied dorsally as well as ventrally with a pair of flaplike appendices, bending backward in a subdorsal and subventral direction, respectively. Each of these ornaments, corresponding to the "deux formations latérales en forme d'épaulettes" of Skrjabin and to the "gros nodules à extrémité obtuse, dirigés vers l'arrière" of Seurat, terminates posteriorly in a free border with two small incisions, thus forming three small teeth. The lateral papillae or amphids are exceedingly well developed and prominent. On both sides of each lateral amphid there is a glistening spinelike formation, which, as can be seen by a lateral-front-end view, is a kind of support of the outstanding amphid. The four submedian papillae are not so conspicuous; each terminates in two points. The mouth opening is guarded by four toothlike formations arranged in the shape of a rectangle, corresponding to the "4 papilles avançant en dehors (lèvres?)" of Skrjabin. The mouth cavity is funnel shaped leading to an elongated club-shaped esophagus.

Male 6.5 to 7.3 mm. long with a maximum width of 0.150 mm. The esophagus is 0.8 mm. long and surrounded by the nerve ring about 260μ posterior to the head. The bursa shows a strong reticulate striation. The well developed lateral lobes are folded ventrally: the dorsal lobe, while distinct and well set off, is extremely small. It is supported by a short, stout dorsal ray, about 60μ long, dividing close to the border of the lobe to form four small tips. The externo-dorsal rays are stout, about 70μ long, terminating with their posteriorly bent, small, hooklike, distal ends some distance from the edge of the bursa. In Skrjabin's Figure No. 13 (p. 478) the distal ends of the externo-dorsal rays are blunt, without the posteriorly bent small hooks; these are also not mentioned by Seurat. The lateral rays have a common stem; the postero-lateral and the medio-laterals parallel and terminate in fine points on the bursal margin; the externo-lateral rays, however, are slightly divergent from the other laterals and have anteriorly bent, hooklike, distal ends, not extending to the border of the bursa. Skrjabin, however, figures (fig. 13, p. 478) the externo-lateral rays as running parallel to the other laterals and their distal ends as extending to near the bursal margin and having no anteriorly bent hooks, the latter also not being mentioned by Seurat. The ventro-ventral and ventro-lateral rays are slightly di-

vergent and pointed distally; the ventro-ventral rays appear smaller than the latero-ventrals. It might be mentioned here that the present description of the bursal rays is in accordance with Lundahl, who writes (p. 284): "Der Schwanzbeutel des Männchens aus zwei schief stehenden, nach aussen konvexen Blättern bestehend; ein jedes von 6 Rippen unterstützt. Von Diesen sind die 3 vorderen vorwärts gebogen, die 3 hinteren stehen gerade nach aussen. Nur die vierte und fünfte gehen bis zum Rande des Beutels." The posterior lip of the cloaca is provided with a pair of sessile papillae. The prebursal papillae are very small. The brownish spicules have a length of about 120μ, dividing distally to form one dorsal and two subventral branches.

Female 10 to 11.5 mm. long and 230μ to 240μ wide. The club-shaped esophagus has a length of 0.9 mm. and is surrounded by the nerve ring at a distance of 250μ to 270μ posterior to the head. The posterior extremity of the body narrows suddenly behind the anus to form a digitiform tail which has a length of 160μ to 180μ. The vulva, a small transverse slit about 120μ long, opens at a distance of about 2.5 mm. from the posterior end of the body. The ovejector has two branches running parallel and anteriad. The intrauterine eggs are oval, relatively thickshelled, and measure 85μ to 90μ by 45μ to 50μ. The most developed ones are in the morula stage, with about 16 to 32 cells.

Hosts.—Dafila acuta, Oidemia nigra, Mareca penelope, Anas platyrhyncha, Anas platyrhyncha domestica, Anser albifrons, Querquedula cyanoptera.

Location.—Under the cuticular layer of the gizzard.

Life history.—Unknown.

Distribution.—Europe (Sweden), Central Asia (Province of Syr-Daria), Africa (Algeria), and United States of America.

Specimens here described.—United States National Museum (Bureau of Animal Industry Helminthological collection) No. 28964.

EPOMIDIOSTOMUM CRAMI, new species

Plate 1, Figures 1–3; Plate 2, Figures 7–10

Specific diagnosis.—Epomidiostomum: Body slender and of a reddish-brown color in living specimens. It is considerably attenuated anteriorly and terminates in a very small, but distinct, head. The cuticle is transversely striated. Just behind the head the striations are more highly developed and irregular, giving this region a very characteristic wrinkled appearance. The postcervical papillae, situated about 390μ posterior to the head end, are inconspicuous. The excretory pore opens ventrally at a distance of about 400μ to 410μ from the anterior end of the body.

The head is 33μ to 36μ wide, being slightly wider dorsally and ventrally than it is laterally. It is provided with a special cuticular expansion forming four well developed head plates. The two lateral plates occupying all the lateral portions and extending somewhat to the dorsal and ventral side of the head have a slightly waved posterior margin. The dorsal and the ventral plates showing the shape of a spheric triangle are smaller, but well marked. The front surface of the head is ornamented dorsally as well as ventrally with a pair of conelike formations. They are arranged in a symmetrical manner and have a length of about 8μ to 10μ. Their pointed free extremities are directed subdorsally and subventrally respectively. These conelike ornaments correspond in every respect to the flaplike formations of *E. uncinatum* described above. The lateral papillae or amphids are exceedingly well developed and prominent, occupying almost the entire lateral portions of the head front. Each lateral amphid is supported by a pair of glistening spinelike formations, which are somewhat more developed than in *E. uncinatum*. The four submedian papillae, each terminating in two points, are not so prominent as the lateral amphids. The mouth opening is guarded by four toothlike formations arranged in the shape of a rectangle. They are somewhat more strongly developed than in the type species. The mouth cavity is funnel shaped, leading to the elongated club-shaped esophagus, which is surrounded by the nerve ring about 300μ posterior to the head.

Male 9 to 10.5 mm. long with a maximum width of 210μ to 220μ. Esophagus 1 mm. long, being, therefore, about one-tenth of the length of the body. The strongly striated bursa is trilobed, the dorsal lobe being extremely small, while the free edges of the well developed lateral lobes are folded over the ventral surface. The dorsal ray is stout, about 75μ long, dividing close to the distal extremity to form two short branches, each of which bifurcates again in a thinner median and a thicker outer branch, both with the tip approximately on the border of the dorsal lobe. The externo-dorsal rays are stout, about 100μ long, terminating with their rounded distal ends some distance from the edge of the bursa. The lateral rays have a common stem; the posterior-laterals and medio-laterals, running parallel, terminate in fine points on the bursal margin, while the blunt extremities of the externo-laterals are slightly bent forward. The slightly curved ventral rays originate from a common base and are pointed distally; the ventro-ventrals appear more slender and shorter than the latero-ventrals. The posterior lip of the cloaca bears a pair of sessile papillae. The prebursal papillae are very poorly developed. The spicules have a length of about 180μ to 200μ, dividing distally to form one dorsal and two subventral branches.

Female 17 to 19 mm. long by a maximum width of 230μ to 240μ. The esophagus is about 1.2 mm. long. The anus lies about 150μ from the posterior extremity of the body, which narrows rapidly behind the anus to a digitiform tail. The vulva is represented by a small transverse slit, about 3.8 mm. from the posterior end. Of the two branches of the ovejector, one runs forward, the other backward. The eggs in the uterus are oval, 75μ to 81μ long by 45μ to 48μ wide, and thick shelled, and in the case of the most developed are in the advanced morula stage.

Hosts.—*Branta canadensis canadensis* and *Chen caerulescens.*

Location.—Under the cuticular layer of the gizzard, especially in the region of the musculi intermedii.

Life history.—Unknown.

Distribution.—North America (United States, collected at Washington, D. C., from a host from Back Bay, Va. (*Branta canadensis*), and from the National Zoological Park, Washington, D. C. (*Chen caerulescens*)).

Type specimens.—United States National Museum (Bureau of Animal Industry Helminthological collection) No. 28959.

Comparison of E. crami with other species of Epomidiostomum.—This species resembles *Epomidiostomum orispinum* (Molin, 1861) Seurat, 1918, and *E. skrjabini* Petrow, 1926, in many respects, especially the general size and shape. It differs, however, from *E. orispinum*, as described by Seurat, in the following respects:

1. The presence of four hooklike formations guarding the mouth opening.

2. The presence of a pair of spinelike, glistening supports at each lateral papilla or amphid.

3. The division of the distal end of the dorsal ray into four small branches. Molin describes, in accordance with his drawing No. 9, (plate 29), the dorsal ray of *E. orispinum* as bifurcated (p. 522 . . . radio medio apice bifurcato . . .), while Seurat gives no description of the ray.

4. The smaller size of the eggs.

It differs from *E. skrjabini* as follows:

1. The presence of the spinelike, glistening supports at each lateral papilla or amphid which differ in position, origin, and shape from similar formations figured and described as "warts" by Petrow in *E. skrjabini.*

2. The division of the distal end of the dorsal ray in four small branches instead of two as in *E. skrjabini.*

3. The distal ends of the externo-dorsal rays are blunt, while in *E. skrjabini* they form a small, posteriorly bent hook.

4. The nerve ring surrounds the esophagus at a distance of about 300μ from the head end, while in *E. skrjabini* Petrow gives the distance as 0.0507 mm.; even if, as I suspect, 0.0507 mm. must be considered as a printer's error, 0.507 mm. would still be an important difference from the corresponding figure in *E. crami*.

There is some confusion in the literature regarding the terms epauletlike formations or festoons. Both terms are used by Skrjabin to signify the flaplike ornaments on the surface of the head in *E. uncinatum*. Seurat, however, used the term festoon for the lateral cuticular expansions of the head in *E. orispinum*, while Petrow calls a corresponding formation in *E. skrjabini* an epaulet. By studying front-end views it is clearly seen that the epauletlike formations or festoons of Skrjabin in *E. uncinatum* (Seurat calls them "nodules") are identical in every respect with the conelike formations of *E. skrjabini*, *E. crami*, and *E. orispinum* (designated as "aiguillons" by Seurat in this last species). The festoons of Seurat in *E. orispinum* and the epaulets of Petrow in *E. skrjabini*, however, correspond to the formations called headplates in *E. crami* by the present writer, in order to avoid the confusing terms epaulet and festoon.

Further it is said by Seurat in his generic diagnosis that the head bears a pair of lateral papillae on each side. The front-end views, both of *E. uncinatum* and *E. crami*, however, show only one exceedingly well-developed and prominent lateral papilla or amphid on each side. Regarding the buccal capsule, which is lacking according to Skrjabin or short and reduced according to Seurat, the present writer agrees with Skrjabin. There is no buccal capsule in either species described here. The mouth opening leads into a short funnel-shaped mouth cavity, supported near the mouth opening by the four toothlike formations and communicating posteriorly with the esophagus.

A further characteristic, not mentioned in the generic diagnosis, is the highly developed striation giving the neck region a typical wrinkled appearance. In order to bring the generic diagnosis of *Epomidiostomum* in accordance with these facts and to simplify it the following emendation is proposed: "Cuticle thick and transversely striated, striations highly developed in the neck region. Head distinct, provided with a special cuticular expansion forming two lateral, one dorsal and one ventral headplates. The front surface bears dorsally as well as ventrally a pair of ornaments, directed subdorsally and subventrally respectively, being flaplike and bent backward in some species, and conelike in other species. Lateral papillae or amphids well developed, prominent. Buccal capsule lacking."

For the purpose of separating *Epomidiostomum crami* from the other species of the genus the following key is appended. In this key

we have regarded *E. querquetulae* Boulenger as a typographical error, the species name evidently being based on the host name *Querquedula*, and at the suggestion of Dr. C. W. Stiles this is amended to *E. querquedulae*.

KEY TO THE SPECIES OF THE GENUS EPOMIDIOSTOMUM

1. Front surface of the head provided dorsally as well as ventrally with a pair of flaplike ornaments, bent backward ..... 2.
   Front surface of the head provided dorsally as well as ventrally with a pair of conelike ornaments, directed subdorsally and subventrally respectively ..... 3.
2. Males 6.5 to 7.3 mm. long, females 10 to 11.5 mm. long; spicules 120μ long, dividing distally into three branches ..... **E. uncinatum.**
   Males 8.8 to 10.5 mm. long, females 13 to 14.5 mm. long; spicules 200μ long, dividing distally into two unequal branches ..... **E. querquedulae.**
3. Males 10.8 mm. long, females 16.7 mm. long; spicules 200μ long, dividing distally into three branches; mouth-opening not guarded by four toothlike formations ..... **E. orispinum.**
   Mouth opening guarded by four tooth-like formations ..... 4.
4. Males 9.5 to 11.5 mm. long, females 15 to 17 mm. long; head provided with four submedian "warts;" dorsal ray dividing distally into two small branches. **E. skrjabini.**
   Males 9.5 to 10.5 mm. long, females 17 to 19 mm. long; head without four submedian "warts," lateral papillae or amphids with a pair of glistening supports; dorsal ray dividing distally into four small branches ..... **E. crami.**

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EXPLANATION OF PLATES

ABBREVIATIONS

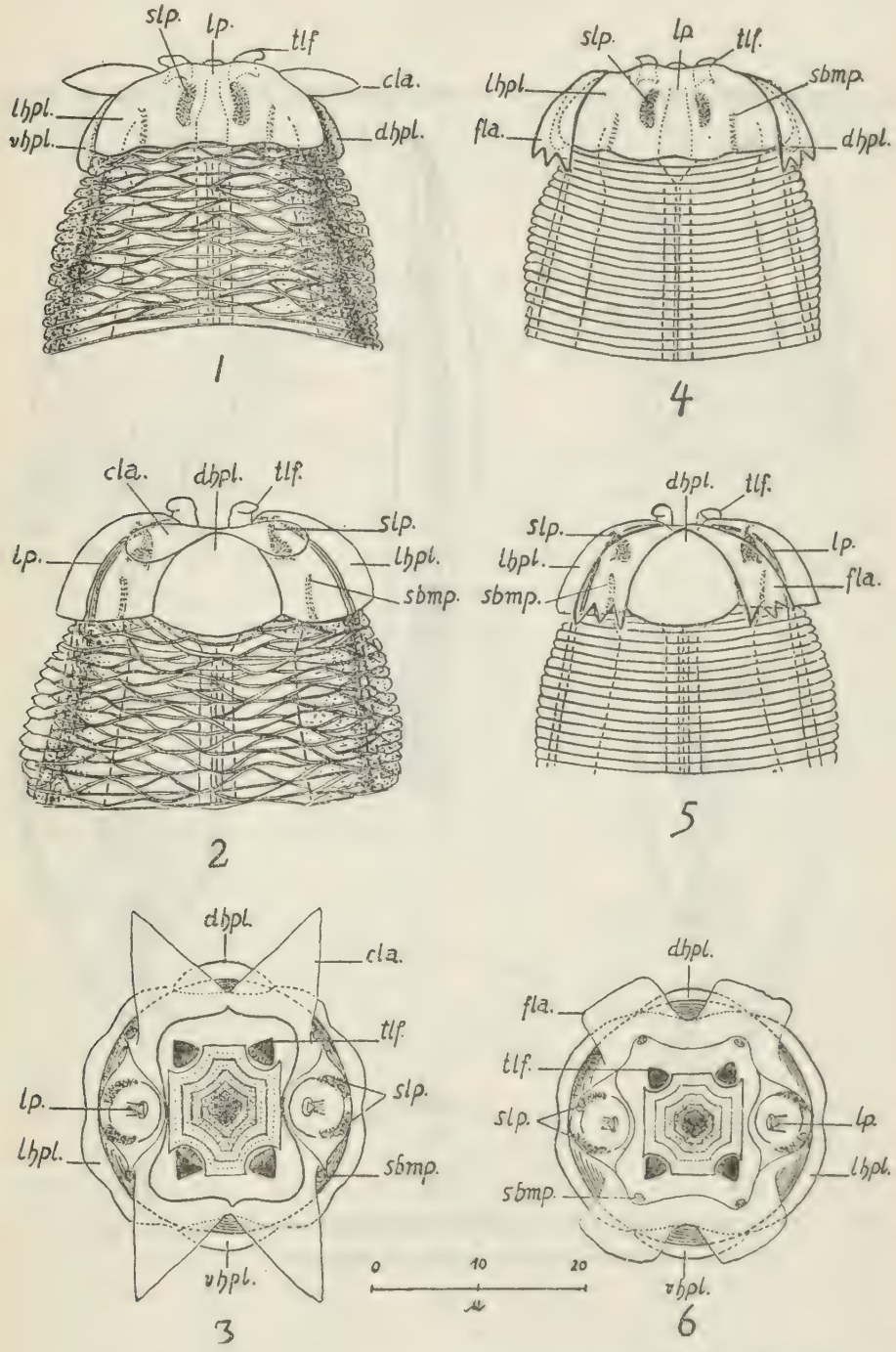
a=anus.
cla=conelike ornament.
d=dorsal ray.
dhpl=dorsal head plate.
ed=externo-dorsal ray.
el externo-lateral ray.
ep=excretory pore.
fla=flaplike ornament.
lhpl=lateral head plate.
lp=lateral papilla.
lv=latero-ventral ray.
ml=medio-lateral ray.
pl=post-lateral ray.
sbmp—submedian papilla
slp=supports of the lateral papilla.
sp=Sessille papillae.
tlf=Toothlike formations.
vhpl=ventral head plate.
vv=ventro-ventral ray.

PLATE 1

Epomidiostomum crami, new species.
FIGURE 1. Head end of female, lateral view.
2. Head end of same female, dorsal view.
3. Head end of same female, viewed en face.
Epomidiostomum uncinatum (Lundahl, 1848) Seurat, 1918.
FIGURE 4. Head end of female, lateral view.
5. Head end of female, dorsal view.
6. Head end of female, viewed en face.

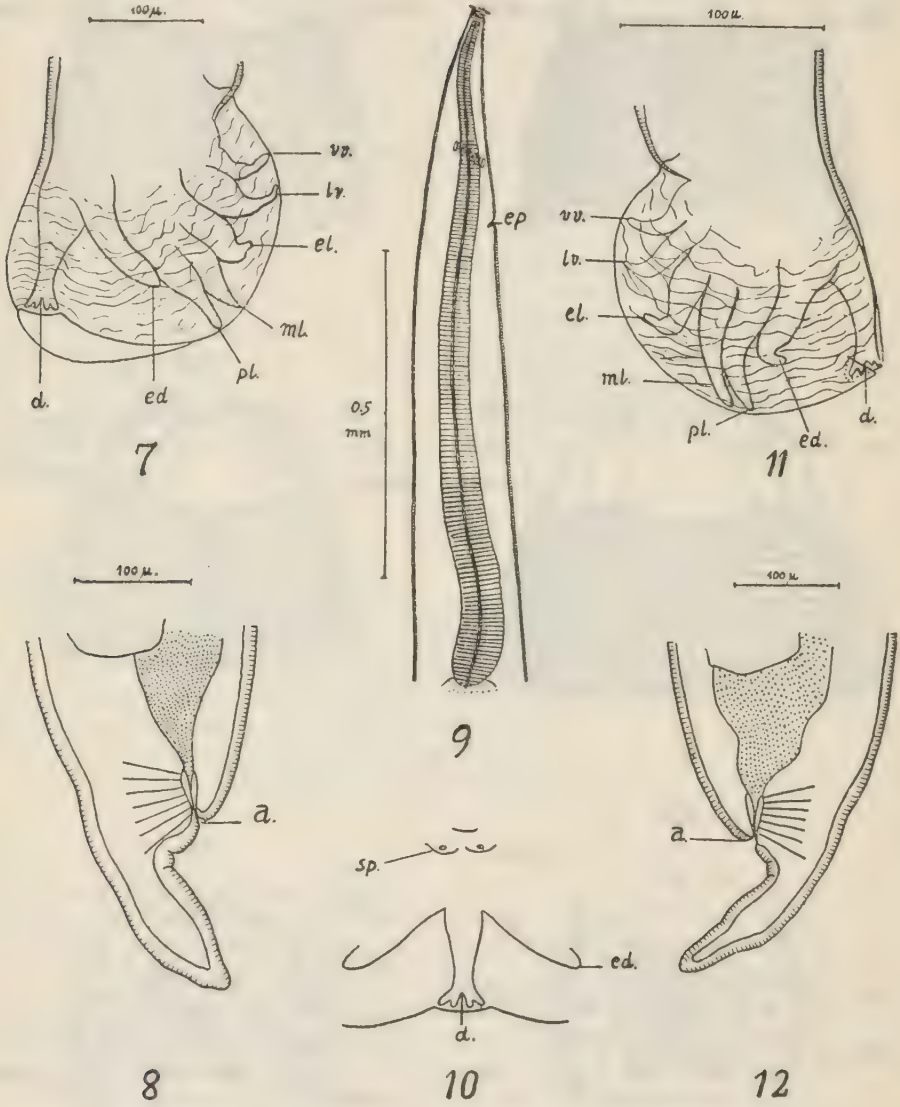
PLATE 2

Epomidiostomum crami, new species.
FIGURE 7. Bursa copulatrix, lateral view.
8. Posterior end of body of female, lateral view.
9. Anterior end of body of female, lateral view.
10. Dorsal ray and cloacal papillae, ventral view.
Epomidiostomum uncinatum (Lundahl, 1848) Seurat, 1918.
FIGURE 11. Bursa copulatrix, lateral view.
12. Posterior end of body of female, lateral view.



EPOMIDIOSTOMUM CRAMI AND EPOMIDIOSTOMUM UNCINATUM

FOR EXPLANATION OF PLATE SEE PAGE 10



EPOMIDIOSTOMUM CRAMI AND EPOMIDIOSTOMUM UNCINATUM

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U. S. GOVERNMENT PRINTING OFFICE: 1931

REDESCRIPTION OF TWO SPECIES OF TREMATODE WORMS FROM THE MacCALLUM COLLECTION, WITH A NOTE ON THE FAMILY PRONOCEPHALIDAE

By Emmett W. Price

Zoological Division, Bureau of Animal Industry, United States Department of Agriculture

Recently Dr. G. A. MacCallum deposited his extensive and valuable collection of helminths and other parasites in the collections of the United States National Museum, thus making the material available for study. In going over this collection the writer found many of the original specimens of species described by Doctor MacCallum. In view of the fact that some of the species which he described were placed in genera no longer recognized as valid except as collective genera, the writer has undertaken to reclassify the trematodes of this collection and to redescribe those of which the original descriptions are inadequate from the viewpoint of present-day standards. This paper contains a redescription of two species of monostomes belonging to the family Pronocephalidae, and in this connection an attempt has been made to revise the family.

MacCallum (1916) described a monostome from the intestine of the French angel fish, *Pomacanthus paru*, for which he proposed the name *Monostomum pomacanthi*. An examination of the available specimens of this species shows that it belongs to the genus *Pleurogonius* Looss, 1902, and represents the only species of this genus known from a fish host.

The specimens available for study are as follows: One specimen, a toto mount stained with carmine (U.S.N.M. No. 8087), labeled "Monostome, int., *Angelichthys ciliaris* (blue angel fish). Aquarium, N. Y., Feb. 5, '14"; 10 specimens (3 slides), stained with hematoxylin (U.S.N.M. No. 8088), labeled "*Monostomum pomacanthi*, int., French angel fish, *Pomacanthus paru*. Aq. May 29, '15"; 1 badly damaged specimen, a toto mount stained with carmine (U.S.N.M. No. 8089), labeled "Distome ?, int., *Angelichthys isabelita*. Aquarium. May 27, '16"; 1 specimen, a toto mounted stained with carmine (U.S.N.M. No. 8090), labeled "Distome, int., *Pomacanthus*

arcuatus. Black angel fish. Aq. Jany. 13, '17"; and 1 specimen, a toto mount stained with carmine (U.S.N.M. No. 8091), labeled "*Monostomum pomacanthi*, int., *Pomacanthus paru*. Aq. Ap. 18, '17." All of these specimens show evidence of having been flattened before fixation and certain details can not be made out. The measurements given in the following description are doubtless considerably in excess of what they would have been had a different technique been followed in the handling and preserving of the specimens.

PLEUROGONIUS POMACANTHI (MacCallum, 1916)

Synonym.—Monostomum pomacanthi MacCallum, 1916.

Specific description.—Pleurogonius: Body elongated, 3.5 to 6 mm. long by 1.25 to 2 mm. wide in the region of the ovary; anterior end bluntly pointed and posterior end rounded. A short distance caudad of the oral sucker, the ventral surface shows a deep depression over which project two shoulderlike structures, one on each side, which are not connected dorsally by a ridge as in *Pronocephalus* and related genera. The cuticle is smooth and without spines. The oral sucker is terminal, 153μ to 236μ in diameter; esophagus 310μ to 465μ long; intestinal ceca extend to posterior end of body, the posterior portions bending medially, passing between the testes, and provided with pocketlike diverticula throughout their entire length. The excretory pore is oval in outline and situated dorsally near the posterior end of the body, but owing to the extreme flattening of the specimens the remainder of the excretory system can not be made out. The genital pores are close together, 1.5 to 2.5 mm. from the anterior end, and situated near the margin on the left side of the body. The testes are ovoid, 524μ to 620μ long by 356μ to 387μ wide, with irregular outline, situated near the posterior end of the body and separated from each other by the terminal portions of the ceca. The cirrus pouch is from 0.93 to 1.5 mm. long by 155μ to 310μ wide and directed obliquely backward; it is strongly muscular and contains a well-developed prostate and a simple, unarmed cirrus. The seminal vesicle is strongly convoluted and lies free in the parenchyma at the base of the cirrus pouch. The ovary is more or less triangular in outline, 310μ to 520μ long by 232μ to 248μ wide, pretesticular, and situated to the right of the median line. The shell gland is about one-half the size of the ovary and lies in the median line caudad of the ovary. The vitellaria consist of ovoid follicles and are situated immediately anterior to the testes. (The masses which are shown in MacCallum's (1916) figure of this species, lying in the extreme posterior end and in the anterior half of the body, and described as vitelline follicles, are intestinal diverticula filled with ingesta.) The

uterus runs anteriorly from the shell gland in more or less regular coils extending beyond the lateral limits of the ceca, and terminates in a well-developed metraterm which is about two-thirds as long as the cirrus pouch. The eggs are oval, 30μ long by 18μ wide, provided with a slender filament at each pole.

Hosts.—*Angelichthys ciliaris*, *A. isabelita*, *Pomacanthus arcuatus*, and *P. paru*.

Location.—Intestine.

Distribution.—United States (New York Aquarium).

In 1917 a peculiar species of trematode was described by MacCallum from the oviducts of *Trionyx aspidonectes ferox* to which the name *Paramphistomum aspidonectes* was given. Poche (1926) in discussing his supersuperfamily Paramphistomida writes that "in no case does this species belong to the genus *Paramphistomum* or to any of the other genera of Paramphistomida which are differ-

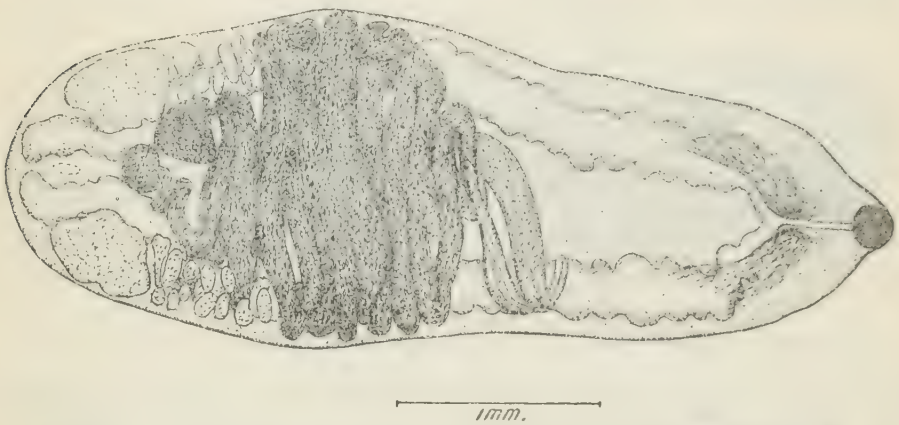

FIGURE 1.—PLEUROGONIUS POMACANTHI (MACCALLUM, 1916). VENTRAL VIEW

entiated at present." Fukui (1929) states: "The general anatomy is apparently that of an amphistome, as the author pointed out. But the situation of the genital pore is entirely different from that of all the other amphistomes, the arrangement of the vitellaria is peculiar and the position of the excretory pore is also remarkable. In general appearance this worm is somewhat like a distome stood on its head." Because of these characters which are so outstandingly different from all other amphistomes, he proposed a new genus, *Opisthoporus*, and family, Opisthoporidae, for this species, assuming, as he says: "that there are no mistakes in the original description."

The specimens of this species which are available for study consist of five specimens representing two different lots. The first consists of four specimens stained with carmine and mounted on a single slide (U.S.N.M. No. 8092) labeled "*Paramphistomum aspidonectes*, oviduct, *Aspidonectes ferox*. Soft-shelled turtle. Aq. May 10, '16."

and the second, one specimen, also a toto mount stained with carmine (U.S.N.M. No. 8093), labeled "*Paramphistomum aspidonectes* n. sp., int., *Trionyx spinifer*, soft-shelled turtle. First found May 10, '16. W. H., Aug. 16, '23." As in the case of *Pleurogonius pomacanthi*, the specimens have been flattened and are somewhat distorted, and some characters can not be made out with certainty.

OPISTHOPORUS ASPIDONECTES (MacCallum, 1917) Fukui, 1929 [1]

Synonym.—Paramphistomum aspidonectes MacCallum, 1917.

Specific description.—Opisthoporus: Body spindlelike in outline, more attenuated posteriorly than anteriorly, 2.4 to 3.2 mm. long by 620μ to 930μ wide at the equator. Cuticle smooth and without spines. Oral sucker subterminal, 310μ to 403μ in diameter. There is a low ridge or collar immediately posterior to the oral sucker which resembles that in the genus *Eucotyle*. This collar is indistinct in the speci-

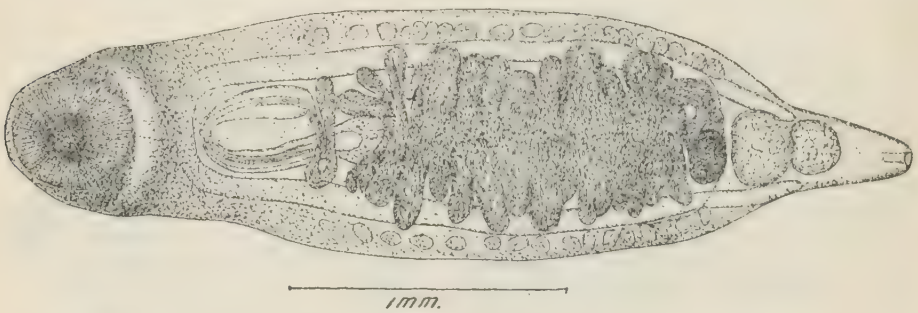

FIGURE 2.—OPISTHOPORUS ASPIDONECTES (MACCALLUM, 1917). VENTRAL VIEW

mens from *Aspidonectes ferox* but is quite evident in the specimen from *Trionyx spinifer*. There is no acetabulum. The esophagus is from 230μ to 310μ long; intestinal ceca simple and without diverticula, and terminating near the posterior edge of the anterior testis. The excretory pore is simple and terminal, but the details of the remainder of the excretory system can not be made out. The genital pore is situated in the median line at the bifurcation of the intestine. It is impossible to determine whether the male and female genital openings are separate or whether they open into a common sinus. The cirrus pouch is pestle-shaped, 685μ to 774μ long, strongly muscular, containing a well-developed prostate and a long cirrus armed with needlelike spines. The seminal vesicle is a convoluted dilation of the vas deferens and lies free in the parenchyma. The testes are

[1] While this paper was in course of publication a paper has appeared by Stunkard (Trans. Amer. Microsc. Soc., vol. 48, no. 3, 1930), in which a description of this species is given. Stunkard had access to an abundance of well-preserved material and his description of this form is, therefore, more complete than that given in this paper.

situated in the posterior end of the body and are unequal in size. The anterior testis is rounded, 248μ by 217μ; the posterior testis is about 200μ in diameter and lies somewhat postero-dorsal of the anterior. Ovary round to oval, 125μ to 155μ in diameter, pretesticular, and situated to the right of the median line. The shell gland is about one-half the size of the ovary and is situated somewhat dorsal to it. The uterus runs anteriorly in irregular transverse coils and terminates in a metraterm which is about one-half the length of the cirrus pouch. The vitellaria are extracecal and composed of large, discrete, rounded follicles extending from the level of the posterior edge of the ovary to the level of the origin of the metraterm. Eggs oval, 23μ long by 13μ wide, provided with a long filament at each pole.

Hosts.—*Amyda ferox* and *A. spinifera.*[2]

Location.—Oviducts and intestine.

Distribution.—United States (New York, N. Y., and Woods Hole, Mass.).

From the above description the genus may be tentatively defined as follows:

Genus OPISTHOPORUS Fukui, 1929

Generic diagnosis.—Pronocephalidae: Body spindlelike in outline, more attenuated posteriorly than anteriorly; cuticle smooth and without spines; cephalic collar present. Oral sucker subterminal; esophagus simple; intestinal ceca without lateral diverticula. Genital pore median; cirrus pouch pestle-shaped, well developed; cirrus spiny; testes situated in posterior end of body with their fields coinciding and zones slightly overlapping, the posterior testis being slightly dorsal of anterior; ovary pretesticular, to right of median line; shell gland dorsal and slightly median of ovary; vitellaria extracecal, extending from ovary to level of origin of metraterm; egg with long filament at each pole. Parasitic in turtles.

Type species.—*Opisthoporus aspidonectes* (MacCallum, 1917) Fukui, 1929.

The genus *Opisthoporus* shows affinities with both the Notocotylidae and Pronocephalidae, but its resemblances to the latter group are greater than to the former. The position of the genital pore is suggestive of the Notocotylidae, but the presence of a cephalic collar and the pretesticular, dextral position of the ovary are characteristic of most members of the Pronocephalidae; *Opisthoporus* is therefore regarded as belonging to the latter family.

Up to the present time the following genera have been included in the family Pronocephalidae: *Pronocephalus* Looss, 1899; *Charaxi-*

[2] The writer is indebted to Miss Doris M. Cochran, of the U. S. National Museum, for the correct names of these hosts.

cephalus Looss, 1901; *Pleurogonius* Looss, 1901; *Cricocephalus* Looss, 1899; *Glyphicephalus* Looss, 1901; *Epibathra* Looss, 1902; *Pycnosomum* Looss, 1899; *Desmogonius* Stephens, 1911; *Diaschistorchis* Johnston, 1913; *Wilderia* Pratt, 1914; *Synechorchis* Barker, 1922; *Hippocrepis* Travassos, 1923; and *Astrorchis* Poche, 1926.

The genera *Diaschistorchis* Johnston, *Synechorchis* Barker, and *Wilderia* Pratt are so similar in shape and arrangement of the internal organs that *Synechorchis* and *Wilderia* should be considered as synonyms of *Diaschistorchis*, and *D. pandus* and *S. megas* apparently should be regarded as being specifically identical as well as congeneric. *Diaschistorchis ellipticus* (Pratt) differs from *D. pandus* in the absence of a cephalic collar and polar egg filaments, and for the present they may be considered as distinct species.

The genus *Hippocrepis* which was proposed by Travassos (1922) for *Monostoma hippocrepis* Diesing, a parasite of *Hydrochoerus capybara*, has been placed in the family Pronocephalidae by Poche (1926). From a study of the descriptions and figures of this species as given by Braun (1901) and Diesing (1855), it is the writer's opinion that the genus *Hippocrepis* should be retained in the family Notocotylidae where it was placed originally by Travassos. *Hippocrepis hippocrepis* is characterized by the presence of two muscular flaplike lobes at the anterior end of the body, a pretesticular ovary, a preovarial shell gland, and a genital pore situated in the median line in the anterior part of the body. The cephalic lobes and pretesticular position of the ovary give this species a superficial resemblance to certain members of the Pronocephalidae. The structure of these lobes, however, according to the description of them as given by Braun (1901), does not appear to be comparable to that of the cephalic collar of members of the Pronocephalidae. The median position of the ovary and preovarial position of the shell gland are characteristic of all genera of Notocotylidae, while in the genera of Pronocephalidae the ovary is situated to the right of the median line and the shell gland is either dorsal, median, or posterior to the ovary.[3] The host relationship of *Hippocrepis*, although not necessarily a deciding factor, is in support of the opinion that this genus should be placed in the family Notocotylidae, as all members of this family are parasitic in warm-blooded vertebrates while those of the Pronocephalidae are parasitic in cold-blooded vertebrates. Fuhrmann (1928) doubtfully places *Hippocrepis* in the subfamily Nudacotylinae, but it seems to the writer that it should be placed in the subfamily Notocotylinae on account of the position of the genital pore and the

[3] Baylis (1928) described a species, *Notocotylus chionis*, in which he says that the shell gland lies behind the ovary. The body which he figures as being the shell gland may be this structure, but if so the postovarial position of the shell gland in a species of *Notocotylus* is unusual and a notable exception to the rule.

distribution of the uterine coils. In the genera of Nudacotylinae the genital pore is postuterine and to the side of the median line, and the uterine coils extend a considerable distance beyond the lateral limits of the ceca, while in the Notocotylinae the genital pore is preuterine and median in position, and the uterine coils are confined for the most part within the lateral limits of the ceca.

Monostomum sphargidis MacCallum, 1921, is considered a synonym of *Astrorchis renicapite* (Leidy). A comparison of specimens (U.S.N.M. No. 8094) of this species from the MacCallum collection with specimens from the Leidy collection shows no essential differences.

Linton (1910) described two trematodes, *Barisomum erubescens*, new genus and species, and *Himasomum candidulum*, new genus and species, which unquestionably belong to the Pronocephalidae. So far as it is possible to determine from the descriptions of these trematodes, there appears to be no justification for regarding these species as belonging to separate genera and *Himasomum* is considered a synonym of *Barisomum*, *H. candidulum* Linton, therefore, becoming *Barisomum candidulum* (Linton). The genus *Barisomum* is apparently closely related to *Glyphicephalus* Looss and *Epibathra* Looss, the principal difference between these genera being in their excretory systems. In *Barisomum* the limbs of the excretory vesicle unite at the anterior end of the body, in *Glyphicephalus* the limbs do not unite anteriorly, and in *Epibathra* the limbs do not unite but are connected by means of a number of transverse anastomoses. Whether the excretory system is a character of sufficient importance to justify the separation of these otherwise identical genera is a matter of personal opinion. Further investigation is necessary before this point can be definitely settled and for the present these genera may be regarded as valid.

In considering the classification of this family certain difficulties arise in regard to the validity of the name Pronocephalidae. Looss (1899) proposed the subfamily Pronocephalinae, but he designated no type genus, although he apparently intended the genus *Pronocephalus* as such, since he bases the name on it and gives the diagnosis of this genus immediately following the subfamily diagnosis. In 1902, he elevated this subfamily to the rank of family and designated *Glyphicephalus* as type genus. This is in violation of article 4 of the International Rules of Zoological Nomenclature which says: "The name of a family is formed by adding the ending *idae*, the name of a subfamily by adding *inae*, to the stem of the name of its type genus." Two solutions of this problem, therefore, appear possible: (1) *Pronocephalus* is intended as type genus of the subfamily Pronocephalinae and the elevation of this subfamily to the rank of family retains *Pronocephalus* as type in spite of the later designation

of *Glyphicephalus* as type, or (2), the name Pronocephalidae is invalidated by the designation of *Glyphicephalus* as type and a new family name must be proposed. *Pronocephalus*, unfortunately, is one of the least typical of the genera of this group, but in view of the fact that the adoption of the second alternative would introduce a new and unfamiliar name for one which has been in use for almost 30 years and would serve no useful purpose, it is the writer's opinion that the family Pronocephalidae should be retained in spite of its atypical type genus.

The genera assigned to the family Pronocephalidae appear to fall into three distinct groups which are regarded as constituting subfamilies and the following classification is, therefore, proposed with keys as formulated here for the separation of the genera:

Family PRONOCEPHALIDAE Looss, 1902

Synonym.—Opisthoporidae Fukui, 1929.

Family diagnosis.—Elongated monostomes, more or less deeply concave ventrally and convex dorsally; anterior end usually provided with a collarlike enlargement; posterior end either rounded or truncate, or provided with two papillalike processes. Oral sucker simple, terminal, or subterminal; intestinal ceca simple or provided with diverticula, and extending to posterior end of body. Excretory pore dorsal, near posterior end of body; excretory vesicle Y-shaped, the stem extending to the shell-gland complex and the limbs extending to the anterior end of body. Genital pore in the anterior half of the body, usually to the left of the median line. Cirrus pouch well developed, containing cirrus, ductus ejaculatorius, and pars prostatica; seminal vesicle convoluted and lying free in parenchyma; testes usually postovarial, entire or divided into follicles, zones coinciding or overlapping, and fields usually separate. Ovary pretesticular or posttesticular, to the right of median line; shell-gland complex median, postovarial; Laurer's canal present; receptaculum seminis absent; vitellaria moderately developed, extracecal, in posterior half of body; uterus consisting of regular transverse coils terminating in well-developed metraterm; eggs relatively small, numerous, usually provided with polar filaments. Parasites of cold-blooded vertebrates.

Type genus.—*Pronocephalus* Looss, 1899.

KEY TO THE SUBFAMILIES OF PRONOCEPHALIDAE

1. Testes postovarial and tandem in position; genital pore in median line. **Opisthoporinae.**
   Testes preovarial or postovarial, lateral and opposite in position; genital pore to left of median line ..... 2.
2. Testes preovarial ..... **Charaxicephalinae.**
   Testes postovarial ..... **Pronocephalinae.**

Subfamily PRONOCEPHALINAE Looss, 1899

Subfamily diagnosis.—Pronocephalidae: Cephalic collar present. Genital pore to left of median line. Testes postovarial, zones coinciding or overlapping, fields separate or touching. Parasites of marine turtles and fishes.

Type genus.—*Pronocephalus* Looss, 1899.

KEY TO THE GENERA OF THE SUBFAMILY PRONOCEPHALINAE

1. Testes intercecal, situated obliquely to long axis of body.
   Pronocephalus Looss, 1899.
   Testes largely extracecal, situated opposite each other ..... 2.
2. Testes divided into several distinct follicles ..... **Diaschistorchis Johnston, 1913.**
   Testes not divided into follicles.
3. Posterior end of body more or less truncate and bearing two small, conical, lobelike projections ..... **Cricocephalus Looss, 1899.**
   Posterior end of body rounded and without lobelike projections ..... 4.
4. Subventral lobes of cephalic collar not connected by a dorsal ridge.
   Pleurogonius Looss, 1901.
   Subventral lobes of cephalic collar connected by a dorsal ridge ..... 5.
5. Ventral surface of body provided with longitudinal rows of glands.
   Adenogaster Looss, 1901.
   Ventral surface not provided with glands as above ..... 6.
6. Testes deeply lobed; cirrus pouch short and hardly extending medially beyond inner limit of left cecum; ceca in wide serpentine undulations ..... 7.
   Testes smooth or slightly indented but not deeply lobed; cirrus pouch long and extending to median line; ceca not as above ..... 8.
7. Body strongly concave ventrally, wider posteriorly than anteriorly; ceca pass between testes ..... **Pyelosomum Looss, 1899.**
   Body not strongly concave ventrally, sides of body almost parallel; ceca pass dorsad of testes ..... **Astrorchis Poche, 1926.**
8. Limbs of excretory vesicle unite near anterior end of body.
   Barisomum Linton, 1910.
   Limbs of excretory vesicle do not unite anteriorly ..... 9.
9. Limbs of excretory vesicle connected by transverse anastomoses.
   Epibathra Looss, 1902.
   Limbs of excretory vesicle not connected by anastomoses.
   Glyphicephalus Looss, 1901.

CHARAXICEPHALINAE, new subfamily

Subfamily diagnosis.—Pronocephalidae: Cephalic collar present or absent. Posterior end of body provided with two conical projections. Genital pore to left of median line. Testes preovarial, consisting of two rows of follicles, either intercecal or extracecal. Parasites of marine turtles.

Type genus.—*Charaxicephalus* Looss, 1901.

KEY TO THE GENERA OF THE SUBFAMILY CHARAXICEPHALINAE

Cephalic collar present; testes intercecal ..... **Charaxicephalus Looss, 1901.**
Cephalic collar absent; testes extracecal ..... **Desmogonius Stephens, 1911.**

OPISTHOPORINAE, new subfamily

Subfamily diagnosis.—Pronocephalidae: Body spindle-shaped in outline. Oral sucker subterminal. Cephalic collar present. Genital pore median. Testes with zones slightly overlapping and fields coinciding. Parasites of soft-shelled turtles.

Type genus.—Opisthoporus Fukui, 1929.

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NEW GENERA AND SPECIES OF NEMATODE WORMS

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This paper contains descriptions of several new genera and species of parasites collected from Asian and American vertebrates. One species, *Bourgelatioides traguli*, new genus, new species, belongs to the suborder Strongylata, while the others all belong to the suborder Spirurata. One of the latter, *Filariopsis arator*, has been placed in a new family, Filariopsidae.

BOURGELATIOIDES, new genus

Generic diagnosis.—Oesophagostominae: Mouth capsule cylindrical, shallow, with thick chitinous walls, divided into anterior and posterior compartments. Posterior end of capsule attached to the cuticle by a chitinous ring and anterior portion of capsule separated from posterior portion by a crown of small leaflets. Anterior border of capsule without leaf-crown, but with four large papillae in the wall. Head end of body delimited in esophageal region by a groove and an overlying flap of cuticle entirely encircling the body. Bursa well developed, the large dorsal ray split for about half its length, each branch again bifurcated; externodorsal very large; posterolateral and mediolateral closely approximated; ventrals closely approximated but split almost to the common base. Spicules equal, moderately long, winged, each terminated by a long coiled filament. Vulva in posterior part of body. Tail of female bluntly conical, ending in a sharp point.

Type species.—Bourgelatioides traguli, new species.

In many respects the worm for which this genus is erected resembles *Bourgelatia*, the single species of which was described from the intestine of pigs in Annam by Railliet, Henry, and Bauche (1919), but it differs in lacking an anterior leaf-crown and in other details of the mouth capsule, in the presence of a groove and overlying flaps in the cervical region, and in the presence of terminal

convoluted filaments on the spicules, a feature which, so far as I am aware, has not been described in any other nematode. Railliet, Henry, and Bauche suggested that *Bourgelatia* belonged with the Oesophagostominae, in spite of the absence of a ventral cervical groove, but Baylis and Daubney (1926) placed it with the Trichoneminae, since, as they point out, the ventral groove is the main distinguishing feature of the Oesophagostominae. Yorke and Maplestone (1926) likewise placed *Bourgelatia* with the Trichoneminae. *Bourgelotioides*, on the other hand, although it resembles *Bourgelatia* in many ways, should probably be included with the Oesophagostominae, which it resembles both in the presence of a cervical groove and in the bursal formula. In this case the cervical groove completely encircles the body, however, and is not merely ventral. In my opinion the separation of the Trichoneminae and Oesophagostominae into separate subfamilies is of doubtful validity, but if the subfamily Oesophagostominae is to stand its definition should be changed so that the cervical groove is not limited to the ventral side.

BOURGELATIOIDES TRAGULI, new species

Figures 2 and 3

Specific Diagnosis.—Bourgelatioides: Coarse cylindrical worms, thickest near the middle, tapering gradually anteriorly from the middle, but tapering very little posteriorly except near the end of the body. Cuticle with very fine striations, more distinct in the female than in the male. Mouth capsule shallow, cylindrical, with heavily chitinized walls, and divided by an inner crown of 20 to 25 small leaflets into an anterior and posterior portion; anterior portion of capsule with four large papillae in the wall. Head about 67μ in diameter at the level of the posterior end of the buccal capsule. The groove and overlying flap which separate the head from the rest of the body are about 200μ from anterior end of body. Esophagus club shaped, about 550μ long.

Male 11.3 mm. long, with a maximum diameter of 420μ, tapering in the anterior 2 mm. and very gradually in the posterior 3½ mm. of the body length. Bursa about as long as broad, about 240μ in either direction. Dorsal ray forked for about half its length, each fork again bifurcated for about half its length; externodorsals very large and thick, extending into the lateral lobes. Lateral rays all about equal in size, the posterolateral and mediolateral closely approximated and fused basally; ventral rays slightly smaller than the laterals, and closely approximated to each other, but split to the common base; all rays reach the edge of the bursal membrane. Spicules 655μ long, exclusive of the terminal filaments, about 24μ

in diameter near the base, then tapering to a fine point, but provided with broad striated alae; each spicule with a terminal long, convoluted filament.

Female 11.5 mm. long, with a maximum diameter of 460μ, tapering gradually in the anterior third and very gradually in the posterior third of the body, and tapering abruptly behind the anus to a sharp point. Anus about 200μ from tip to tail; vulva, provided with prominent lips, about 250μ anterior to the anus. Eggs in uterus about 77μ by 40μ, in early stages of segmentation.

Host.—Tragulus javanicus (Javan mouse deer).

Location.—Small intestine.

Locality.—Calcutta Zoological Garden, Calcutta, India.

Type specimens.—United States National Museum, helminthological collection No. 8097.

This worm in many respects resembles *Bourgelatia diducta*, described from the intestine of pigs in Annam by Railliet, Henry, and Bauche (1919). The worms, of which only one male and one female were collected, were found associated with a few specimens of *Haemonchus contortus*.

CYSTIDICOLA HARWOODI, new species

Figure 1

Specific diagnosis.—Cystidicola: Small slender worms, cylindrical for the greater part of their length, tapering at the ends. Cuticle rather coarsely striated at anterior end, the striations disappearing in both sexes near the level of the posterior end of the esophagus. Head truncated, 80μ to 85μ in diameter, with two blunt, rounded lateral lips and a pair of minute toothlike structures on the dorsal and the ventral side. The mouth opening is in the form of a dorsoventral slit, the walls of the cylindrical vestibule appearing to come almost together in dorsal or ventral view, but spreading out into a funnel-shaped opening in lateral view. Vestibule 155μ to 160μ long and 10μ to 12μ in diameter, with thick chitinized walls. Esophagus slightly over 4 mm. long, in two parts, not sharply separated, and neither distinctly muscular; anterior portion 1.6 to 1.7 mm. long and about 52μ broad; posterior portion 2.4 to 2.6 mm. long and about 85μ broad. Nerve ring about 250μ to 350μ from anterior end of body. Excretory pore about 40μ behind nerve ring.

Male about 9 to 11 mm. long with a maximum diameter of about 120μ. Testis begins at about the junction of middle and posterior thirds of the body, passes forward with very slight convolution, turns backward some distance behind the end of the esophagus, and proceeds as a straight sperm duct to the cloaca. Cloacal aperture

140μ to 145μ from posterior end. Tail with narrow alae, provided with four pairs of preanal and three pairs of postanal papilla, all slender, and narrower at the base than at the tip. In some specimens an additional very narrow preanal papilla and a postanal papilla are visible. Tail bluntly pointed. Spicules unequal, the shorter one trowel-shaped, 135μ to 145μ long and 15μ broad, the longer one 385μ to 400μ long and only about 7μ to 8μ broad for the greater part of its length, although it widens out to about 10μ or 12μ at the proximal end.

Female 14 to 16 mm. long with a diameter of about 285μ. Vulva situated at approximately the center of the body. Vagina extends backward about 250μ and then forks into an anterior and a posterior uterus filled with eggs. The ovaries are moderately convoluted, the loops of the anterior one extending forward to the region of the junction of the anterior and posterior portions of the esophagus, those of the posterior one extending almost to the posterior end of the tail. Tail very short and conical, the anus situated about 110μ from the tip. Eggs oval, measuring about 42μ by 26μ, with thick shells but without the terminal filaments described by Leiper (1908) for *C. farionis*.

Host.—*Salvelinus fontinalis.*

Location.—Stomach.

Locality.—Near Elizabethtown, Adirondack Mountains, New York.

Type specimens.—United States National Museum, helminthological collection No. 8098; paratypes No. 8099.

These worms, members of the family Thelaziidae, were found by Mr. P. D. Harwood in considerable numbers in the stomachs of brook trout from Roaring Brook near Elizabethtown; all of nine specimens from that locality were infected. Nine other brook trout from Lily Pad Pond, in the same general neighborhood, were negative. A number of specimens of brown trout, *Trutta fario*, found in the same locality as the brook trout, were negative. This is the first record of a Cystidicola parasitic in the stomach; the type species, *C. farionis*, is an inhabitant of the air bladder, occasionally being found in the esophagus. The air bladders of these fish contained no parasites.

LITOMOSOIDES, new genus

Generic diagnosis.—Filariidae; Filariinae: Body slender and cylindrical, with cuticle very finely striated except at the extremities, where it is smooth. Head bluntly rounded, the mouth without lips or papillae. Oral vestibule a slender tube provided with thick chitinous walls; esophagus of moderate length, not divided into two portions, and straight except for a slight bulbous enlargement at the anterior end, into the anterior part of which the vestibule extends,

the anterior end of the esophagus being attached to the side walls of the vestibule. Vulva situated anteriorly behind the junction of the esophagus and intestine. Ovejector long, with a bulblike enlargement, with thick muscular walls at the vulvar end. Posteriorly the vagina opens into a thin-walled tube filled with embryos, which extends posteriorly a short distance and then splits into two uteri, which continue posteriorly almost to the anus. Tail of female long, rounded at the tip, without any embellishments. Posterior end of male coiled, with a long fingerlike tail, rounded at the tip, with a number of pairs of inconspicuous postanal papillae and no preanal papillae. Spicules very unequal, the longer one divided into a troughlike anterior part and a more slender posterior part which terminates in a filament. Shorter spicule troughlike, also with a terminal filament.

In many respects this genus is close to the genus *Litomosa* Yorke and Maplestone, 1926, but differs in the character of the oral vestibule and anterior end of the esophagus, in the position of the vulva, in the absence of processes at the tip of the tail in both sexes, and in the presence of postanal papillae.

Type species.—Litomosoides sigmodontis, new species.

LITOMOSOIDES SIGMODONTIS, new species

Figures 4, 5, 6, and 7

Specific diagnosis.—Litomosoides: Slender worms, cylindrical, tapering to a bluntly rounded head anteriorly, and to a rather elongate and slender conical tail posteriorly. Cuticle with very fine striations except near the ends of the body. Head truncated in dorsoventral view, unevenly rounded in lateral view, the mouth being situated somewhat toward the ventral side. Oral vestibule 20μ to 23μ long, with a narrow cylindrical lumen and heavily chitinized walls which do not have straight parallel sides externally, but are drawn out into points where the muscular fibers of the esophagus attach to it. Esophagus muscular, not divided into separate parts, 600μ to 660μ long, straight except for a bulbous enlargement anteriorly into which the posterior half of the vestibule is sunk. Females over twice as long as males.

Male about 24 to 28 mm. long with a maximum diameter of about 130μ to 140μ. Reproductive tube straight, without convolutions. Cloacal aperture about 180μ from tip of tail. Tail rounded at end, tapering for about half its length behind the cloacal aperture, and then almost cylindrical. No preanal papillae; four pairs of small postanal papillae, nearly equally spaced, the most distal one about midway between cloaca and tip of tail; first pair of papillae, nearest

the cloaca, very inconspicuous. Spicules unequal, the shorter one chitinized and trough-shaped for about three-fourths of its length, at which point it has an elbowlike projection; terminal portion membranous and very delicate; chitinized portion of spicule 75μ to 80μ long, total length, to end of membranous tip, 100μ to 105μ. Long spicule with total length of 185μ to 295μ; proximal two-fifths trough-shaped, chitinized, followed by an apparent break, then a portion partly chitinous and partly membranous, ending finally in a delicate filament.

Female 50 to 65 mm. long, with a maximum diameter of about 300μ to 325μ. Vulva situated about 1.25 mm. from anterior end, about twice the length of the esophagus behind the anterior end of the worm. Vulva opens into a large, muscular, bulblike structure, from which a thick-walled muscular vagina, nearly 1 mm. in length, continues backward, and in many specimens loops forward again before changing to a thin-walled tube filled with embryos. The latter tube remains single for a length of about 300μ to 400μ before splitting into the two uteri. The latter continue almost to the anus as nearly straight tubes, only slightly convoluted by forward loopings. Tail very slender, terminal half with almost parallel sides, rounded at tip, about 625μ long.

Embryos in uterus about 100μ to 105μ long, unsheathed, with pointed tails.

Hosts.—*Sigmodon hispidus*, and white rat.

Location.—Thoracic cavity.

Locality.—Houston, Tex.

Type specimens.—United States National Museum helminthological collections, No. 8100, paratypes No. 8101.

This species is very close to *Filaria circularis* von Linstow, 1899, described from another rodent, "*Hesperomys sp.?*" from Porto Alegre, Southern Brazil, which now becomes *Litomosoides circularis* (von Linstow, 1899). Von Linstow's species differs from *L. sigmodontis* in a number of details, particularly in being relatively more slender, in the shorter tail of the male, in the presence of seven instead of four postanal papillae, and in the different size of the spicules. *L. sigmodontis* occurs in a high percentage of cotton rats in the vicinity of Houston and was found also in a white rat born and raised in the Rice Institute animal house, where some infected cotton rats were kept.

FILARIOPSIS ARATOR, new species

Figures 8, 9, and 10

Specific diagnosis.—*Filariopsis:* Body slender and cylindrical, with bluntly rounded extremities. Cuticle smooth with traces of very fine striation, but provided with an irregular, transparent excre-

tion which is thrown into rough, uneven fimbriae. (Fig. 10.) Some specimens are nearly entirely enclosed in this rough coat, while in others there are only occasional patches of the cuticle which are provided with it. Mouth provided with three inconspicuous lips. Esophagus short and muscular, about 250μ long.

Male about 50 to 60 mm. long with a diameter of about 210μ, uniform throughout nearly the whole length. Both ends of body bluntly rounded, the tail more bluntly than the head. Cloacal aperture only about 30μ to 35μ from tip of tail, the latter without alae or any distinct papillae, although there is a wartlike prominence just behind the cloacal opening. The spicules are short, equal, and converging at the tip, united by a membrane for the greater part of their length, and each ending in a single chitinous point. In lateral view they are strongly curved, like the blade of a sickle; the proximal ends, which are free, suggest the handles of a plow. They have a length of about 150μ. The gubernaculum is a single, thin, curved plate of chitin, appearing splinterlike in side view and slightly crescentic in optical section as seen in a ventral view of the worm.

Female about 80 to 90 mm. long, with a diameter, practically uniform for nearly the entire length of the body, of about 260μ. Posterior extremity bluntly conical, the anus almost terminal, less than 50μ from the tip. Vulva posterior, near anus, 130μ to 150μ from tip of tail. Uteri filled with embryos throughout a large part of the body; uterine embryos measured about 230μ to 280μ in length, with a diameter of about 12μ near the equator, the head bluntly rounded, the tail drawn out into a fine point.

Host.—*Cebus* species.

Location.—Lungs.

Locality.—Chicago, Ill.

Type specimens.—United States National Museum, helminthological collections No. 8120; paratypes No. 8121.

These worms were collected by Dr. W. H. Taliaferro in large numbers from the lungs of a number of specimens of South American monkeys captive in Chicago.

According to van Thiel's description, the type species, *F. asper*, differs in a number of important respects from the species here described, and it is possible that they may eventually have to be separated into different genera. The most significant differences are in the tail and spicules of the male. *F. asper* is described as having small alae and five pairs of papillae, whereas no such structures could be discerned in *F. arator*. The spicules of *F. asper* are described as separate structures, supported by two gubernacula, whereas in *F. arator* the spicules are united into a single plowlike structure and there is a single gubernaculum. The cuticle of *F. asper* " is covered by irregularly placed conical elevations, which, in the middle of the

body, measure 22.8μ by 11.4μ, but which are absent or very small on the head and tail." *F. arator*, on the other hand, has a cuticle roughened by what seems to be a hardened excretion; there is no regularity in the size of the elevations, and they are irregularly distributed in patches. Whether or not this roughness of the cuticle is comparable with that described by van Thiel, I am unable to determine. His figure of the protuberances does not in any way resemble the roughened cuticle of *F. arator*.

In spite of these differences, the two species show a number of striking resemblances. Both are parasites of the lungs of monkeys and are alike in general form, structure of the mouth and esophagus, position of the vulva, and the almost terminal position of the anus in both sexes, and in the form of the embryos. It is quite possible that other related forms will be found in the lungs of South American primates.

The genus *Filariopsis* was erected by van Thiel (1926) for a worm which was collected from the lungs of Surinam howler monkeys (*Alouata=Mycetes seniculus* Linnaeus), and referred by him to the Filariidae. The genus differs radically from typical filariae in the posterior position of the vulva, in the short muscular esophagus, and in the noncoiled tail of the male. It is possible, as suggested by Dr. M. C. Hall in correspondence, that the genus *Filariopsis* belongs with the spirurids rather than the filariids. Its posterior vulva suggests this, but its other peculiar characters—short muscular esophagus, three inconspicuous lips, and noncoiled, nonalate tail of the male—are no more characteristic of the spirurids than of the filariids. The lack of paired lips, the very slender body, the position in the host, and the uteri filled with microfilaria-like embryos are strongly suggestive of relationship with the filariae. The worm can not go into any of the families of Spirurata, either in the Spiruroidea or Filariodidea, as at present constituted, and a new family, Filariopsidae, is therefore proposed for it; this family is tentatively placed in the superfamily *Filarioidea*. The following definition is tentatively suggested for the family:

FILARIOPSIDAE, new family

Family diagnosis.—Filarioidea: Body very long and slender, cylindrical for nearly its entire length. Mouth surrounded by three lips, which may be very inconspicuous; no chitinized buccal cavity. Esophagus short, thick, and muscular. Cuticle without distinct striations, but with conical elevations or a roughness produced by a hardened secretion. Tail of male very short, not coiled, and with very small alae or none at all, with or without papillae. Spicules equal, sometimes united; gubernaculum present, either single or

paired. Vulva of female shortly anterior to the anus. Uteri filled with large numbers of embryos. Parasitic in lungs of mammals.

Type genus.—Filariopsis van Thiel, 1926. It is possible that the genus *Oslerus* Hall, 1921, also belongs to this family.

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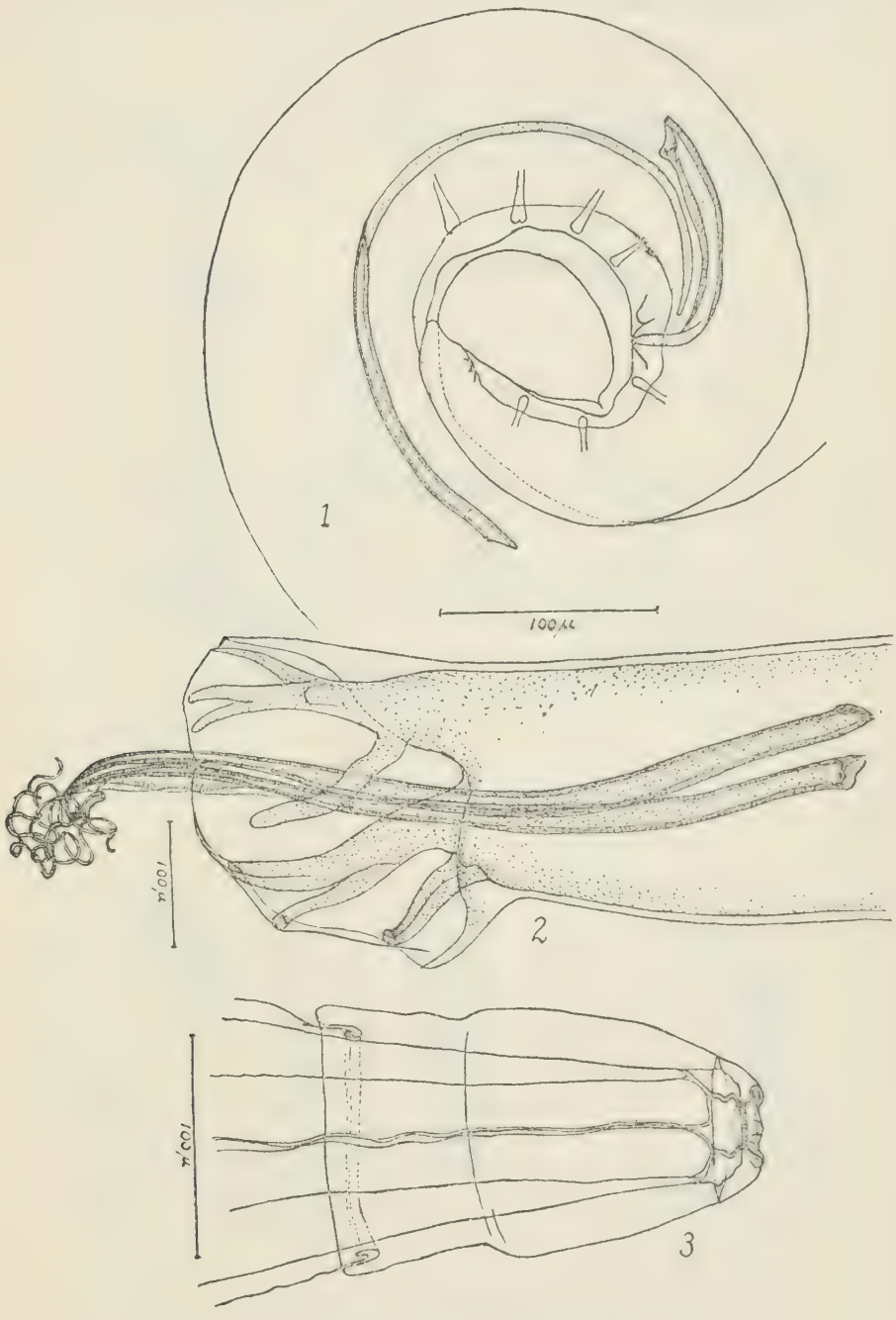
EXPLANATION OF PLATES

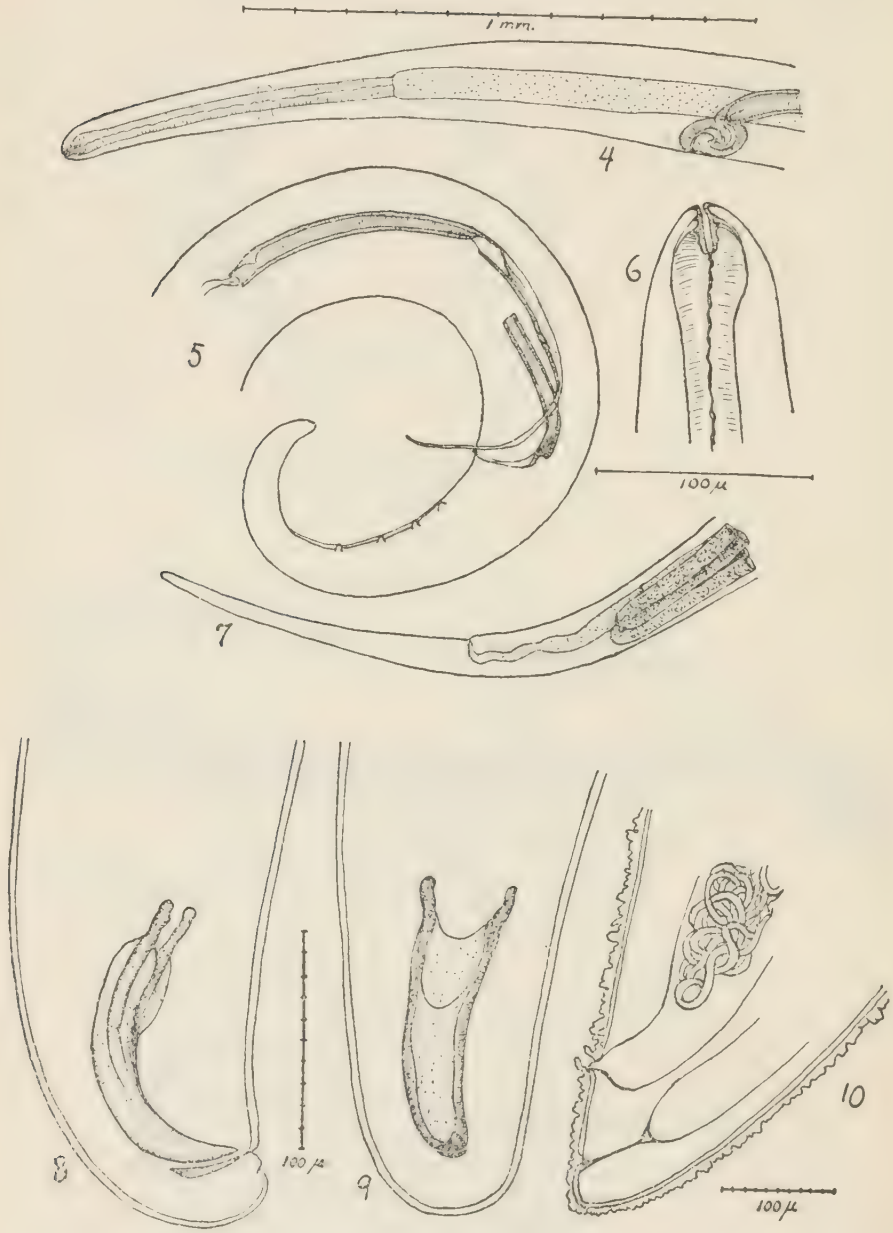
Plate 1

Figure 1. *Cystidicola harwoodi.* Posterior end of male.
2. *Bourgelatioides traguli.* Posterior end of male.
3. *Bourgelatioides traguli.* Head.



CYSTIDICOLA HARWOODI AND BOURGELATIOIDES TRAGULI

FOR EXPLANATION OF PLATE SEE PAGE 10.



LITOMOSOIDES SIGMODONTIS AND FILARIOPSIS ARATOR

FOR EXPLANATION OF PLATE SEE PAGE 11.

PLATE 2

FIGURE 4. *Litomosoides sigmodontis.* Anterior end of female.
5. *Litomosoides sigmodontis.* Posterior end of male. (Magnification same as figure 6.)
6. *Litomosoides sigmodontis.* Head, much enlarged.
7. *Litomosoides sigmodontis.* Posterior end of female. (Magnification same as figure 6.)
8. *Filariopsis arator.* Posterior end of male, lateral view.
9. *Filariopsis arator.* Posterior end of male, ventral view.
10. *Filariopsis arator.* Posterior end of female.

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